Science Education

REPORT OF THE COMMITTEE OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING APPOINTED TO COOPERATE WITH THE COLLEGE ENTRANCE EXAMINATION BOARD

FUNCTIONS OF THE COMMITTEE OF THE N.A.R.S.T.

This committee was originally appointed by the President of the National Association for Research in Science Teaching, W. G. Whitman, at the request of the College Entrance Examination Board. The task was to propose syllabi in science for the consideration of the College Entrance Examination Board in its effort to revise its definitions of requirements. These syllabi should attempt to define the courses to be pursued by students in secondary schools preparing to take the Board's examinations at the so-called "second level" of science. The second level examinations are given in either of two categories, namely: Physical Science or Biological Sciences. Each examination is presumed to evaluate two years of science study.

In the report of the Commission which prepared the new examination program, certain purposes and desired outcomes of the new program were stated. These were:

> 1. "The examination in physical sciences should integrate two years' work, one each in chemistry and physics.
> 2. "The comprehensive examination in biological science at the second level should test the students' ability in and grasp of not only the biological principles but also the physical and chemical fundamentals involved in biological processes.
> 3. "The Commission is of the opinion that by such integration, economies of instruction can be achieved—with possible extension of subject matter treated."

The announcement of the new examinations as set forth in the Board's Definition of Requirements, 1936 (page 5), makes these statements:

1. "The examination in the physical sciences will be of the comprehensive type. It will be based upon a two-year integrated course in physics and chemistry in which information and methods from other sciences may be introduced as supplementary material.
2. The examination in biological sciences which will be of the comprehensive type will be based upon an integrated course in the biological sciences."

THE PROBLEM OF ORGANIZATION OF MATERIAL

The committee saw its first task to be that of deciding upon a plan of organizing the courses. The question resolved itself into whether to break down the present subject categories above the ninth year and make a single two year course in the physical sciences and another for the biological sciences; or to retain the present titles of physics, chemistry and biology. The best available opinions of leaders in science education, the recommendations of the committees of the National Education Association, the National Society for the Study of Education (31st Yearbook) and the reports of the Commission of the Progressive Education Society were studied. Questionnaires were sent to different groups of teachers. The syllabi of the College Entrance Board, the American Chemical Society, the State of New York, the State of Pennsylvania, the North Central Association, Los Angeles, California and others were carefully evaluated. Experimental courses with fused subject matter organized about problems of social importance which offered promise of being

suggestive of workable plans, were studied to the extent that these were available to the committee. Also recently published textbooks in science both at the secondary and college level were studied for the trends that might be noted. Altogether these data were evaluated in terms of the contributions of science training to general education in a democracy.

DEFINITIONS AND TERMINOLOGY

At the beginning of their work, the committee was a bit confused over the term, *integration*. This has become a very popular word in educational literature but appears to be used in a number of different ways. For example, in the quotations from the College Entrance Examination Board, given above, the "integration" of the examinations is not the same as "integration" of the subjects. Yet it seems to be assumed that this is the case. Of course the dictionary gives one the right to apply the term, integration, to any process of "joining together". Hence the new second level examinations, which have now been used in science for two years, are a "joining together" of two fields of science in one examination—hence a kind of integration. On the other hand, most schools still provide only one-year courses respectively in biology, chemistry and physics. A few schools have attempted to give a two year course in physical science; a fusion or integration of two subjects: chemistry and physics. But preparation for the second level examination may be made, and at present is made, by taking two separate one-year courses. Here, of course, it is to be hoped that some integration of the student's experiences occurs as he recognizes the same principles at work in many situations and in both science fields.

Moreover, there is much ado about "social integration", the process of fitting individuals to live together in a democratic society. In other places we hear of "intellectual integration" or "emotional integration". Recently state programs have been "integrated"; the curriculum must be "integrated" and subject matter must be "integrated". This last named usage in connection with subject matter is perhaps the most confusing of all because to some this integration of subjects means the fusion of two courses such as physics and chemistry. To others the integration of subjects means the organizing of materials about problems of daily living, or "aspects of living" or in some way other than the traditional, logical form.

This committee was not commissioned to define for others the usage of this term. But in view of the varying interpretations possible, the committee has agreed on the following: "Integration is the bringing together or associating of experiences, within an individual, so that broader meanings and wider generalizations are attained". The experiences may be intellectual or emotional; but the individual does his own integrating; he cannot have it done for him.

Hence to avoid other misunderstandings, the joining of two subjects in one course will be called a "fused course" and the joining of two subjects in one examination will be called a "comprehensive examination." In the case of examinations the fields or scope of the examinations should be mentioned, as, a comprehensive examination in physics and chemistry (or physical science).

INTERPRETATION OF THE ASSIGNMENT

In thus limiting the meaning of some of the moot terminology, the committee had no intent to evade the issues nor any purpose to change the assignment. Rather it was the purpose to interpret the request of the College Entrance Examination Board so that the suggestions of the committee and whatever syllabi might be forthcoming would be truly helpful in working toward a solution of its problem of re-defining its requirements in science.

The committee is in general agreement with the functions of science study in general education as set forth by the 31st Yearbook, "A Program for Teaching Science," and with the viewpoint of the Commission for the Progressive Education Association (The Thayer Committee's report). It (the committee) looks upon the learning process as an *integration* of experiences and the goal of educative processes to be *integrated* individuals. Thus the purpose of general education is to provide for the needs of individuals in developing their understanding and abilities, to enrich their lives and to fit them for effective participation in a democratic society.

CURRICULUM PROBLEMS

The need for changes in the requirements of the College Board is of course one aspect of the problem of general education. A changing social order requires changes in social institutions—including schools. It appears that high school curricula have gradually become dominated by the requirements for college entrance. This has occurred in spite of the fact that college authorities had no wish to prescribe courses for any except those applying for entrance to college. Yet the progressive education movement may be looked upon —in part at least—as a reaction against outmoded practices in secondary schools. A demand is being made for curricula in high schools which meet the needs of all adolescents whether or not they propose to enter college.

The College Entrance Examination Board recognizes the influence of its syllabi upon courses in secondary schools and likewise the need for courses which are differentiated for other than college minded students. However, its position is that the responsibility for the non-college student remains with the secondary school administration. Its own task is conceived to be to define what training is desirable for those planning to go to college.

It follows that it is not the function of this committee to prescribe courses for the non-college student. However, the committee feels that the problems of general education must be solved with regard to the whole picture and the needs of education in a democratic society. It recommends therefore that the College Entrance Examination Board re-examine its requirements and examination practices looking toward the possibility of the selection of college entrants by a different type of test. Is it possible, by more comprehensive examinations, or by other means, to select from the graduates of secondary schools those possessing the capacity to profit by further study at the college level—and without prescribing the courses or their content? If this could be done, secondary schools could proceed to provide curricula designed to meet the present needs of students at the secondary school level. These needs vary with individual differences in age, sex, intelligence, emotional equipment, economic condition, social position, aptitudes, vocational aims and others. It is certain that the needs of all are not provided for by the prescriptions designed for candidates for college.

VIEWPOINT AS TO THE LEARNING PROCESS

In the *31st Yearbook,* as well as in the report of the Thayer Committee, considerable emphasis is placed upon "generalizations," "understandings," "big ideas," "principles which ramify through human experience," and "emotionalized attitudes." The committee believes that *generalizations* and *principles* should be the outcomes of the study of scientific facts; and that proper *habits* and *attitudes* should be the goals of the modification of behavior. As has been stated previously, however, this committee does not believe that these values are the necessary concomitants of the study of science. They may result if certain methods are used and if certain experiences are provided. In other words the learning process seems to be a synthesis of experiences.

Generalization seems to be the process

of identifying certain elements common to a number of experiences. The concept which includes these experiences in a *whole* is a generalization. But it should be noted that generalizations result from experiences and are built from them. The statement of a big principle or a broad generalization by the teacher or the textbook does not constitute learning nor understanding of such a principle. Understandings therefore are made broader and better by a process of synthesis or "integration" of experiences.

The laws of habit formation are well known. If an important aim of science training is the formation of scientific habits of thinking and acting, psychology tells us how to do it. The committee believes this aim is most important and recommends that the methods of teaching science be in conformity to the laws of habit formation so that scientific methods may be learned as habits and not as verbal statements.

The matter of "attitudes" is not so simple. Some of the so-called attitudes seem to be habits; others are definitely drives or emotional aspects of behavior. Of course it must be recognized that overt behavior is the result of certain drives and impulses, within the individual, which seek satisfaction. However, since little is known about them and since a class or a group of individuals cannot all have the same "drives," it seems futile to build a system of science teaching on a belief that each individual must always do only what his momentary drive urges him to do. At all events the present system of mass or group instruction must find some other basis. As to such attitudes as curiosity, inquiry, respect for truth, openmindedness, tolerance, etc., there is evidence that much can be done to inculcate them by the methods of habit formation, by example of the teacher and by the socialized atmosphere of the class. They fall outside of the subject matter of a syllabus and cannot be taught as topics, but the committee believes that the College Board should set them up as goals, provide some recommendations for their inculcation and attempt, at least, to measure in some fashion the degree to which they are acquired by students.

METHODS AND GENERAL PRINCIPLES

The proposals of the committee can be looked upon as a compromise between the organization of science studies about socially important problems and the organization in the traditional subject divisions of science. The committee has investigated a number of courses in science of the "fused" type as well as some of the experiments with programs of study and curricula bearing the label, "integrated." It has reached certain beliefs based on the available evidence and upon the known principle of the learning process. These opinions are:

1. The shortcomings of schools are traceable not so much to the organization of materials into subjects as to a faulty teaching process in which study of subjects has become the end rather than the means of training youth.
2. Any organization of science materials is a human plan and not in the nature of things.
3. Some organization and system is necessary; for instruction, guided entirely by needs of different individuals, cannot function in the present system of mass education or large class groups.
4. The organization of science into the divisions or fields of chemistry, physics, biology, *et al.*, is a product of man's experience and intelligence. In each division certain principles are grouped together because they relate to some unifying idea. The learning of principles thus connected is most easily made to be developmental—*i.e.*, leading to understanding and to generalizations which have wide application.
5. The abandonment of the values of the organization by fields of science seems unwise until a better organization has been proposed. The organization of science materials about the so-called "socially important problems" seems to be no more "psychological" nor any less "logical" for the student than the organization about science principles. Any organization is artificial as far as the student is concerned until he feels some mediate or immediate interest in it. To be sure, the aspects of living such as health, air, water, communication, transportation are important to every individual. Yet for the most part they are *problems* of the adult and students at the secondary

school level are not responsible for these matters. Moreover, the assumption that students feel a need or have interest, curiosity or concern about these topics more than about the principles of science has little to support it in the studies of students' interests which have been reported.[1] In other words, these so-called "problems of living" are problems of adults and are proposed by the teacher. Stimulation or motivation provided by the students' own personal inconvenience or "felt need" seldom exist. Hence the organization of science courses as well as the providing of the motivation remain among the functions of the teacher.

6. The process of integration of any individual's experiences seems to be a synthesis made by the individual himself. He may *become* an integrated personality or he may not; but he cannot be *made* integrated simply by the organization of subject matter into new categories. The motivation, the real experiences, the atmosphere of the school, the attitude of the teacher, the conscious generalization of facts learned, the habit of using the scientific method—methods of teaching science, in short—seem to be more important than the organization of materials in a syllabus.

7. The committee has therefore retained the subject categories of biology, chemistry and physics—above the ninth year—has organized these subjects in terms of principles, has pointed out the important cross-references and social implications, has made "energy" a unifying principle throughout the study of all science, has provided a Unit for a review of each subject in terms of some important aspects of living, and has suggested some principles of teaching science (to accompany the syllabus).

It is the belief of the committee that the adoption of these changes will lead to better integration of students' experiences and will enable science study to take a worthy part in the development of adult individuals who are able and ready to participate in a democratic society.

METHODS

The principles of science teaching which follow are adapted from a number of sources. They represent the judgment of the leaders in science education and are based on what is known of the psychology of the learning process.[2] They are referred to the College Entrance Examination Board with the suggestion that they be incorporated with the new Definition of Requirements in Science.

1. Science study is to be looked upon primarily as one of the means for general education. Hence it should meet certain needs of young people who are developing their own capacities and who are learning to participate in a democratic society. Methods should be guided primarily and continuously by this aim. The methods of acquiring information, interpreting facts and the study of science principles should be looked upon as means for the training of students.
2. The contributions which science study can make are believed to be chiefly:
   (a) training in habits of thinking and and working.
   (b) training in attitudes—toward work, toward the physical world and toward other people.
   (c) development of understandings of the principles of science which help to explain the environment

[1] Fitzpatrick, F. L. *Science Interests.* Bureau of Publications, Teachers College, Columbia University, New York, 1936.

[2] Bibliography of recent reports on the teaching of science:

Reorganization of Science in Secondary Schools. U. S. Bureau of Education. Bulletin No. 26. 1920.

Syllabus in Physical Science. New York State Board of Regents. 1926.

Tentative Syllabus in General Biology. New York State Board of Regents. 1933.

A Program for Teaching Science. Thirty-first Yearbook of the National Society for the Study of Education. Public School Publishing Co., Bloomington, Illinois. 1932.

Science in General Education. Report of the Commission of the Progressive Education Society. V. T. Thayer, Chairman. Appleton-Century Co., New York, 1938.

Report of the Committee on Standards for Use in the Reorganization of Secondary School Curricula. North Central Association Quarterly. 1927.

Instruction in Science. Bulletin of the U. S. Bureau of Education 1932. No. 17.

Courses of Study in Science for Senior High Schools. Dept. of Public Education. Commonwealth of Pennsylvania. Bulletin 74. 1932.

Outline of Essentials for High School Chemistry. Am. Chem. Soc. 1936.

and which may serve as means of controlling the environment or of adjustment to it.

(d) training in cooperativeness, self direction, tolerance, social sensitivity and the like, which are qualities essential to the democratic way of life and which may be developed in all school activities.

3. Science subjects—biology, chemistry and physics should be treated as branches or divisions of science and not as distinct fields of study. The same methods should be seen to pervade all science study and the principles learned in one field should be consciously related to the implications of these principles for the other fields of science.

4. The study of science should be carried on as an inquiry or investigation. This inquiry should be, or at least appear to the student to be, a continuing investigation in which questions arising in the solving of one problem naturally lead to further investigation. The methods of scientists should be exemplified by the teacher and practiced both by teacher and students throughout the course.

5. Problems which have their origin in, and are identified with the daily aspects of living should be set or proposed for each unit of work. These problems should serve as motivation —not merely formally, but vitally. Unless a problem is, and can be shown to be important in daily living or important in helping to solve some problem of living, it probably does not belong in the course of study for high school students.

6. Experiences with objects and phenomena should be provided by the teacher. The observations and experimentation with the materials by the student should *lead* to the understanding of principles and the statement of these principles by the student himself. Demonstrations, experiments, specimens, reading, gathering data from out-of-school excursions—these are means of solving problems and of meeting the needs of students for experiences. The methods of study and work should give training in the scientific habits and attitudes desired.

7. Principles and generalization should *not* be stated in advance of experiences or of the inquiry which are necessary for understanding. In other words, the principles are to be arrived at by the inductive method or by what is sometimes called the developmental method.

8. After a principle or generalization has been developed, it is equally important that it be *used*. Other problems of living and of other fields of science in which the new principle is involved should be studied and identified consciously with it. As many such applications as possible should be made for each principle. It should be noted that the enumeration or simple memorization of the names of examples of applications of the principles is not what is meant; nor is this adequate for the learning process. If a principle is to become functional it should actually be used in situations and perplexities other than the one in which it was developed. Psychologists tell us that nothing is really learned until it can be used.

9. Students should be trained to rely on their own observations and to base their beliefs upon facts. In class situations the habit of critical attention to unsupported assertions of others as well as the habit of presenting evidence or reasons for one's own statements should be encouraged.

10. The social implications of science principles should be used both as motivation and as applications of each unit

of study. This should be looked upon by teachers and students as one of the valuable opportunities of science study *i.e.*—the learning to face facts and to use facts in arriving at beliefs about problems of living. Of course training in these habits is possible in all fields of study. But science is particularly adapted for this training because of the possibility of using objective materials and of studying phenomena directly.

11. Some of the habits which should be emphasized in the study of science (*i.e.* scientific methods) are:

1. Dependence upon facts.
2. Presenting evidence or reasons for beliefs and statements.
3. Keeping in mind constantly the problem which is being studied.
4. Making experiments under controlled conditions to get facts.
5. Keeping accurate records of data and observations.
6. Planning work before starting it.
7. Suspending judgment until evidence is collected.
8. Openmindedness or willingness to change beliefs upon the basis of evidence.
9. Discussion of problems with others and tolerance of others' opinions.
10. Listening patiently to criticism and correcting faults if the criticism is valid.
11. Industriousness, self reliance, and perserverance.

12. Some of the attitudes which may be inculcated in the study of science under the proper direction and leadership are:

1. Respect for truth.
2. Respect for other persons.
3. Spirit of cooperation and tolerance.
4. Active curiosity and inquiry about the world.
5. Willingness to change beliefs upon the presentation of evidence (i.e. openmindedness).
6. Confidence in a general cause and effect relationship of events and a consequent skepticism of superstitious beliefs.
7. Desire for self development and growth.
8. Ideals such as honesty, patience, persistence, fairness, thoroughness.

SEQUENCES

Physical Sciences. To meet the Board's requirements in preparation for the "second level" examinations in physical sciences, either a fused course for two years, or one year of physics and chemistry may be provided by a school. While the committee believes it unwise for the College Entrance Examination Board to prescribe a fused course or a course organized in terms of socially important problems at this time, yet it would like to encourage experimentation along this line. As the courses have been organized heretofore, there is little choice as to which subject should come first. Studies of results of standardized tests and of regents examinations in New York State indicate that girls are more successful with chemistry than with physics. Also the fact that physics requires more mathematics for its mastery than does chemistry has been used as an argument to have physics follow chemistry. Others argue that chemistry is more abstract than physics and should therefore be postponed until after physics. The practice throughout the country is no guide. For while biology is studied usually in the tenth year, either chemistry or physics is elective in the eleventh and twelfth years, and in most places any one of the sciences—biology, chemistry or physics is elective in any year above the ninth. Hence sequence is left a matter of opinion.

Nevertheless the committee believes that a definite sequence is desirable—if not universally the same sequence, at least the same in each school or school system. The following recommendation is made: (1) In each school or school system a definite sequence should be adopted and adhered to; (2) the teacher of the second course should be thoroughly acquainted with the syllabus of the preceding course and should base the study in the second course upon the principles learned in the first; (3) the concept of energy—its manifestations, sources, transformations and necessary connection with all phenomena should be the unifying principle of all physical science.

Biological Sciences. The sequence of chemistry and biology is difficult to fix on

valid psychological or logical grounds. Biology depends more upon chemistry than the reverse. Yet there is no reason why the principles of chemistry necessary to understand respiration, digestion and metabolism in general, may not be learned when the need arises in the biology course. In this case, if biology precedes chemistry the principles of oxidation solution, osmosis, catalysis, neutralization and other simple ideas of chemical theory need presumably only to be extended in the second course. They need not be taught as new concepts when chemistry is studied but should be rather be depended upon as a foundation. It is therefore possible to adapt biology so as to have it precede chemistry. In fact this is the recommendation of the 31st Yearbook and of the Tentative Syllabus in General Biology of the State of New York.

On the other hand, there are some good reasons for urging that chemistry be the tenth year science and serve as the first science of both the physical and the biological sciences. Chemistry is a requirement for either the biological sciences or the physical sciences for the second level examinations. Hence for students who cannot decide at the end of the ninth year (because of lack of experiences in either) whether to choose the biological or physical science group, it would be preferable to take chemistry during the tenth year. The decision as to which group (physical or biological) could then be postponed until the end of the tenth year and the chemistry would serve equally well as the first science of either sequence. The committee believes these reasons are of sufficient importance to recommend a sequence although it does not wish to be dogmatic. The sequences recommended are:

Biological Sciences. Chemistry—Biology.
Physical Sciences. Chemistry—Physics.

In the biological sciences as well as in the physical sciences, *energy* should be the unifying concept. The phenomena of life as manifestations of energy, and life functions as the means of getting, transforming and using energy become increasingly meaningful to the student. Thus in either sequence the student is led to an increasingly broad understanding of "energy" as the fundamental basis of the explanation of all phenomena.

LABORATORY WORK

Laboratory work of both kinds—demonstration and individual—should be administered so as to give training in scientific habits of inquiry. It should not be used exclusively for information. The experiments listed in the existing syllabi for physics and chemistry seem adequate for the necessary objective learning experiences.

The committee recommends that as a general rule the principles of each science field should be developed through the use of objective materials. Much of this development is quite as effective by class investigation and demonstration as by individual exercise. However, it is recommended that at least thirty individual laboratory exercises be required. This individual work should be directed so as to give training in self reliance, initiative, faithful reporting of facts and in the habits of scientists. To this end, the individual laboratory work should not consist simply of following directions but (some of it at least) should require planning by the student and the use of experimentation to solve problems.

In biology, the woods, fields, museums, home gardens, parks, zoos, beaches, lakes, public health agencies, and all aspects of home and community life should provide problems and projects. The investigation and the collection of data will require work outside of the classroom; but the projects should be looked upon by both teacher and student as the most vital part of the course. Demonstrations and the class study of living materials will of course be used in the classroom to provide the experiences

needed for the understanding of biological principles.[8]

CONCLUSION

The accompanying syllabi attempt to meet the criteria just proposed. The committee wishes to emphasize its belief that faulty teaching methods are responsible for more failures in science than is either the content or the plan of organization. Moreover, to secure the outcomes desired, in terms of changes in students, a more intensive and less extensive study of the several fields of science than are here outlined would be better. Two factors, however, may operate to render the mastery of the principles—numerous though they are—less difficult. In the first place, the training in science in grades seven, eight and nine, when this becomes the general practice, should be a good foundation both as to information and habits of work, for the more specialized study of the second level. Secondly, cooperation of the teachers of the subjects in each sequence will result in avoidance of repetition and in economy of time, as well as better understanding of the relationship of science fields to one another. It is hoped that many teachers will experiment with a two year fused course, especially in the physical sciences.

In conclusion, as a result of this study, the committee has reached the belief that a more comprehensive study of the articulation between secondary schools and colleges should be undertaken. The functions of each should be better defined. Secondary schools are attempting to develop to their greatest extent the capacities of all its students, and to teach them to live together efficiently in a democratic way. College training, even in times of unemployment, can be justified only for those able to profit by it. It seems possible that the College Board could devise comprehensive tests to select qualified college entrants with less emphasis upon special subjects than is made by such syllabi as are herewith submitted.

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[8] *Note:* It is assumed that students who undertake the study of science for the second level have had introductory science in the 7th, 8th and 9th years of school. Likewise it is assumed that training in health habits and some study of human physiology are given consideration by other agencies of the school. In school systems where these assumed conditions do not prevail, it is the usual practice to have biology precede chemistry.

TEACHING NUTRITION IN BIOLOGY CLASSES

AN EXPERIMENTAL INVESTIGATION OF HIGH SCHOOL BIOLOGY PUPILS IN THEIR STUDY OF THE RELATION OF FOOD TO PHYSICAL WELL-BEING

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The author's desire to investigate the teaching of nutrition in biology classes developed from a realization of the need adolescents have for instruction in this field. The instruction commonly furnished in this area tends to be academic rather than functional, and tends to ignore the newer findings concerning nutrition. Social factors make adolescents increasingly prone to scorn adult-imposed conventions. They tend to discard accustomed patterns of behavior and experiment in every conceivable manner. Their experiments in food, usually in the form of indulgence, do not yield results immediately, hence they are apt to draw conclusions that the old well-established health habits they have been following are valueless.

Recent developments in the science of human nutrition are of such importance that they offer abundant rewards in human welfare. Sherman,[1] who is a professor of chemistry, states that, "Present knowledge of nutrition and food values plainly shows the way, first to the avoidance of nutritional deficiencies, and then to the attainment of higher levels of health than we would otherwise enjoy." . . . "The option which the newer knowledge of nutrition offers is the option of a longer lease of healthier life, of an earlier and longer prime of life, of more buoyant health throughout the whole life cycle, as a result of taking a larger proportion of the needed calories in the form of protective foods."

The problem of this study may be expressed: Can the study of the relation of food to physical well-being in high school biology classes be so organized and taught that it is truly educative?

What is known about nutrition was surveyed and organized around the major generalization, "Food intake is closely related to physical well-being. A prolonged lack of any essential food nutrient results in widespread disturbance of function and often of structure. Starting with a normal body, an intake of each essential food nutrient, which just meets requirements, results in passable health; an optimal intake of each essential food nutrient results in physical vigor."

The chief "contributory ideas" which further define the area are:

1. The body needs foods to supply energy and an optimal supply of these foods is close to minimal need.
2. The body needs foods for growth, repair, and reproduction; an optimal supply of these body building foods is considerably above minimal needs.
3. The body needs regulative and protective foods; and an optimal supply of some of those is several times greater than minimal need.
4. Each cell within the body must have a continual supply of food and oxygen for its vital processes; waste materials resulting from these processes must be removed from the body.
5. Mankind has developed largely on the use of "whole foods" as contrasted with the highly refined foods used today.
6. Foods may be classed according to the essentials they furnish, which in turn serve as a basis for selection of a widely varying optimal diet.
7. The newer knowledge of nutrition indicates that, starting with a normal body, optimal nutrition results in physical vigor.

Then questions were raised concerning the implications of these nutrition materials to the major aspects of man's expe-

[1] Sherman, H. G. *Food and Health.* New York: Macmillan Company, 1932, pp. 185–187.

rience. How are they related to human development, to personal and public health, to home and family life, to social-civic life, to economic industrial life, and to man's thinking?

Questions and problems which it seemed should be vital to an adolescent's understanding of this area, together with numerous activities and approaches were then arranged in a tentative working schedule.

In order to carry out an experimental investigation of pupil growth it was necessary to select certain attributes for intensive study and to provide descriptive means for evaluating other aspects.

Three instruments were constructed to measure attitude toward nutrition information, and use of nutrition information in the interpretation of current advertisements. Anecdotal records of pupil's behavior and work was secured from stenographic reports of the first teaching situation and from parents by a questionnaire. The teachers who tried out the educational experiences were also asked to appraise them.

To construct an attitudes test, about 600 pupil statements representing attitudes towards diet were collected. Eventually forty items were selected and camouflaged by forty similar items in other areas. This test was then validated by having twenty graduate students in nutrition take it. These graduate students served as expert judges on the validity of the items. A scoring key was made in accordance with the agreement of the judges. This is shown in the table.

Table I
Validation of Attitude Test

Number judges agreeing on item	Number of items	*Points of credit* Per item	Total	Cumulative
20	9	4	36	36
19	9	4	36	72
18	3	3	9	81
17	3	2	6	87
16	3	2	6	93
15	3	2	6	99
14	1	1	1	100

The reliability of the test was determined to be .81 by the split-half method.

To construct the information test, true-false questions were written for each of the important problems in the tentative teaching schedule. A test of some 90 odd questions was then tried out on a group of pupils. Results of the highest quartile were plotted against those of the lowest quartile, and those items which did not distinguish between the lower and upper quartiles were discarded. After additional refinement a test was constructed. This was also validated by the same twenty experts and the 78 items on which judges agreed were kept. The reliability of the test was found to be .75.

To construct an application of principles test, verbatim statements were selected from current food advertisements, arranged in a test form and pupils asked to rate in four degrees of truth or falsity. A trial form was given and nondiscriminatory items were discarded. A revised form was constructed and validated by the same twenty experts. Points of credit were assigned according to their agreement.

Table II
Validation of Application of Principles Test

Number of judges agreeing on response	Points of credit assigned to response
18–20	5
15–17	4
13–14	3
9–12	2
8	1

The test was split into two equal halves on several bases and the reliability determined to be .75.

These tests were given as initial and as final tests.

The first experiment was conducted at the Lincoln School of Teachers College. Stenographic reports of behavior and measures of persistence (a year later) were possible in this situation. The extended experiment included different teachers in varying situations. The situations included

two private schools in New York City, and eight selected public schools in New Jersey, Pennsylvania, Delaware, and Ohio. The towns in which these schools were selected ranged from a few hundred population to over four-hundred-thousand population.

In the first experiment the teaching was done by the investigator with the cooperation and guidance of the school Home Economics teacher, and a graduate student in nutrition. Especial effort was made to collect descriptive evidence of pupil's reactions. An experimental group and a control group of ninth and tenth graders and the matching of equivalent groups for a comparison of the gains made.

That the study of nutrition in biology classes can be truly educative is shown by the analysis of the data obtained from the tests and from the descriptive appraisal. Instead of treating the data obtained from the initial tests and from the final tests separately, a distribution was made of the differences between the initial and final test scores made by individual pupils. From these differences the mean gain and other statistical relationships were determined.

The data obtained from all the pupils

TABLE III

GAINS MADE BY MATCHED EXPERIMENTAL AND CONTROL GROUPS AT THE LINCOLN SCHOOL, 1936-37

Test	Group	N	Gains in Final over Initial Tests		Gains in Retention over Initial Tests	
			G	G/σG	G	G/σG
1	Experimental	15	12.40	3.28	13.27	4.57
	Control	15	—5.80	1.67	—5.93	1.87
2	Experimental	15	13.00	5.16	9.33	2.87
	Control	15	—7.13	3.33	—8.27	4.67
3	Experimental	15	11.60	3.61	12.80	3.30
	Control	15	2.67	0.71	—0.67	0.02

G is mean gain.
σG is standard error of mean gain.

were selected. Initial tests were given at the beginning of the experimental period, final tests were given at the end of the experimental period, and retention tests, a year after the instruction.

In the extended experiment much effort was required to familiarize the participating teachers with the area of instruction and with experimental methods of teaching. The organization was carefully rewritten. Many specific suggestions for teaching were made. Help was given in the preparation of diets and in the securing of animals and other equipment essential to the unit. The participating teacher used the same test forms at the beginning and at the end of the experimental period. Two teachers in one school cooperated by giving the tests without instruction during the interim. This allowed a measure of the practice effect from taking the tests, in the Lincoln School experimental group show that they made significant gains in each of the three tests. When measured a year later they still retained a considerable proportion of the gains made. Practically all of the gains made in the attitude test, test 1, were retained.

Two equivalent groups of pupils were selected from those who had studied nutrition and those who had not studied nutrition. These groups were matched in age, I.Q., and initial test scores on each of the tests given. This was done by "peeling from the distribution" those individuals which tended to destroy the equivalence in any of the bases.

Comparisons of the gains in the above table shows clearly that no part of the gain should be attributed to the practice effect of taking the tests. Furthermore, the experimental group retained, a year after

TABLE IV

GAINS MADE BY MATCHED EXPERIMENTAL AND CONTROL GROUPS IN THE EXTENDED EXPERIMENT, 1937

Groups	N	Test 1		Test 2		Test 3	
		G	G/σG	G	G/σG	G	G/σG
School B	30	16.80	5.58	20.73	4.89	6.83	2.43
School C	15	21.67	5.12	40.40	15.79	7.67	2.79
School G	15	12.40	5.54	14.13	4.91	6.00	2.41
School I Control	15	3.27	0.80	2.07	0.76	0.80	0.21

G mean gain.
σG standard error.

their classwork, all of the gains made in the attitude test and in the application of principles in interpreting nutrition advertising, and lost but one-fourth of the gains made in the information test.

In the extended experiment nine of the eleven teachers obtained significant shifts in attitude, eleven out of eleven obtained significant gains in information, and six out of nine obtained significant gains in the applications test. Lack of some books and reference material accounts for the two failures in attitude and two of the three failures in applications. The class was very small in the third case. To further analyze the results three equivalent groups were matched against a control group having similar socio-economic background on the same basis as in the first experiment.

The gains made by the matched groups are shown in the above table. All of the experimental groups made gains which may be considered significant in each of the attributes measured. In fact the gains made in attitude and information are especially noteworthy in each case.

Intercorrelations were run between the scores made by all of the pupils in the various groups to ascertain whether or not the tests measured different attributes, and to see whether the intercorrelations were higher or lower in the initial or in the final tests.

The fact that the intercorrelations be-

TABLE V

INTERCORRELATIONS BETWEEN SCORES MADE ON TESTS 1, 2 AND 3 IN THE EXTENDED EXPERIMENT, 1937

School	Initial Test			Final Test			N	Significance Level (Fisher's table)	
	r_{1-2}	r_{2-3}	r_{1-3}	r_{1-2}	r_{2-3}	r_{1-3}		5%	1%
Lincoln Biology	.050	.246	—.025	.199	.539	.334	17	.482	.606
Lincoln 9th Gr.	.386	.256	—.024	.154	.153	.364	46	.291	.376
School H	.191	.239	.351	.237	.233	.019	26	.388	.496
School B	.149	.215	.238	.061	.161	.174	79	.225	.293
School E	.479	.610	.465	.433	.031	.368	15	.514	.641
School C	.411	.396	.510	.431	.102	.145	18	.468	.590
School G	.039	.039	.209	—.143	.089	.160	48	.285	.369
School D Teacher 1	.439	.144	.481	.115	—.109	.265	44	.298	.384
School D Teacher 2	.270	.215	—.0076	.066	.234	.229	46	.291	.576
School I Control	.241	.175	—.063	—.129	.296	.110	28	.374	.478

Significance Level
- r below 5 per cent level may be considered not significant.
- r between 5 per cent and 1 per cent may be considered significant.
- r above 1 per cent may be considered highly significant.

tween the attributes measured were not significantly above zero in either the initial or final tests indicates that the tests measured different attributes.

Six of the nine intercorrelations between tests 1 and 2, between tests 2 and 3, and between tests 1 and 3 were lower in the final than in the initial tests. This indicates that pupils progressed at different rates in the attributes measured, that pupils were not satiated by the experiences, that pupils did not achieve the mature intergrations held by nutrition experts, and that pupils grew in ways that should enable them to make increased use of opportunities and more mature judgments in the area of nutrition.

An estimate of the interests of high school pupils in the relation of food to physical well-being can be gained by scrutinizing expressions of their parents when they were studying nutrition, by noting the reactions of pupils when participating in the study of nutrition, and by reading the opinions of teachers who have used these nutrition materials in their biology classes. The statements made by parents were written in response to a letter asking for any expressions which would help in appraising the unit of work. The statements made by pupils were copied from their notebooks. The opinions expressed by teachers were given after they had experimented with these materials in their own biology classes.

One mother reports as follows:

> "I have noticed a decided change in John since he began his work in diet. I myself have been intensely interested in dietetics for years, but the changes I wanted to introduce in the home were received so belligerently that I was balked. John would not listen to any talk about vitamins; he refused whole wheat bread, insisted that white rice tasted better than brown, etc. Now I hear him saying when he has his milk at bedtime, 'I think I'll have an extra glass because I missed one today,' or to his younger brother who is still protesting, 'Cut it, you ought to be glad to get brown rice instead of polished rice.'"

Another parent notes that as the study progressed at school, her daughter asked for milk for the in-between meal lunch at four o'clock. She overheard her daughter saying, "I have really learned a lot from that unit of work. Perhaps I shall not always act on it, but I know a lot more about foods than I ever did before. Even if I may not always observe it now, it is the kind of information one does not forget. I know that it has been useful. . . ."

A mother of an overweight girl writes:

> "Balanced meals have become of vital concern to Mary. Restaurant meals are criticized and commented upon. We live in a perpetual calorie count. Mary has lost ten pounds since the work in nutrition started. I think the material covered in your work has been of great interest. We have been told at home about the experiments, and have heard many of your discussions repeated. Interest that carries beyond the class and becomes a part of everyday experience seems particularly worthwhile."

And from another home:

> "Bob has been very interested in the nutrition course. He has changed agreeably in regard to eating between meals and in eating too many sweets."

From pupil notebooks came the next quotation:

> "We have finished a topic on nutrition. So what? Will it be forgotten like most of the other subjects will be over the summer? It won't—at least I won't forget it. It has proven one of the most interesting and certainly the most useful subject we have learned this year, besides being the best thing in science I've had. I think it should prove hard forgetting what I've learned although I certainly don't intend to start 'counting the calories.'"

One teacher appraises the nutrition experiments by saying:

> "The animal feeding experiment was most significant. The experience of the guinea pig that lost weight so rapidly from lack of vitamin C and finally had an intestinal hemorrhage, and then with the application of vitamin C recovered so quickly, carried weight with the class. Charts took on more meaning when supplemented by this experience. . . . We added an experiment that indicated that soda lime takes up CO_2. . . . One copy of such books

as Sherman's "Food and Health" is inadequate for class needs."

A second teacher reports he is decidedly enthusiastic about the experiment which challenged him to do the best teaching he has ever done. He added much reference material, constructed supplementary tests, and had pupils conduct numerous laboratory experiments on the relation of chemistry to nutrition.

Several times pupils expressed the idea that they were getting more worthwhile material, applicable to their everyday life, than in any other subject.

Another teacher reported:

"The animal experiment was enjoyed by all and most of the results were good. Our homemade respiration apparatus, gave only fair results, as a result of poor construction, yet the boys and girls enjoyed working with it, and with a few improvements it will remain a permanent part of our laboratory equipment." "I know of nowhere else the majority of my group would be given this training. The unit also ties up the processes of digestion, assimilation, respiration, and circulation which are oftentimes considered by biologists in too isolated a fashion."

Many other instances of teacher and pupil appraisal of this unit could be given if there were space.

The findings may be summarized in outline form:

I. Findings and their application:
   1. The study of the relation of food to physical well-being was found to be truly educative in that:
      a. Pupils in varying types of school situations made significant gains as a result of instruction in their attitude towards food in diet, their information concerning the relation of food to physical well-being, and their application of principles in the interpretation of food advertisements.
      b. Selected samples of pupil work illustrate a high degree of interest and understanding achieved as a result of educational experiences.
      c. Quotations of parents indicate that pupils do use knowledge gained from this study as a basis for action in their daily lives.
      d. Appraisal of educational experiences by participating teachers gives their testimony as to the worth of such experiences in high school biology classes.
   2. Pupils retain most of the gains made when tested one year after the experimental period:
      a. Study of all pupils from first experimental situation shows that roughly all of the gains made in attitude, two-thirds of the gains made in information, and one-half of the gains made in application of principles are retained after the duration of one year.
      b. Study of two equivalent groups of fifteen pupils each, matched in age, intelligence quotient and scores made on Initial Tests 1, 2 and 3, show that these pupils retained all gains made after the duration of one year in attitudes and application of principles, but lost about one-fourth of the gain in information they had made. The equivalent group which did not have such instruction rated slightly lower on each retention test on each initial test. Therefore practice effect had little influence on test results.
   3. Effective application of this type of organization can be made in various kinds of schools by different biology teachers:
      a. Experiments suggested proved stimulating and workable.
      b. Use of animals resulted in interest and understanding not otherwise secured.
      c. The two schools not making significant gains were seriously handicapped by lack of pupil reference material—having only one or two copies of necessary books for use of a hundred or more pupils. School libraries need refurnishing.
      d. Teaching of these vital materials resulted in teacher growth and indicated ways to make the biology curriculum more functional.
   4. That this study meets the needs of adolescents is shown by:
      a. Their interest and enthusiasm in the study.
      b. Their achievement of increasingly mature understandings.
      c. Their attitude towards diet, indicating that they increasingly consider its nutritional effects.
      d. Their use of understanding achieved in their interpretation of food advertisements.
   5. That most of the intercorrelations between attributes measured are not significantly above zero in either the initial tests or the final tests indicates that the tests used measured different attributes.
   6. That most of the intercorrelations between attributes measured were lower in the final

than in the initial tests, even though significant gains were made in each test, indicates that:

a. Pupils progressed at different rates in the attributes measured.
b. Pupils were not satiated by the experiences.
c. Pupils did not achieve the mature integrations held by nutrition experts.
d. Pupils grew in ways that should enable them to make increased uses of opportunities and maturer judgments in this area.

II. Interpretations:

1. The cooperating teachers demonstrated that the educational experiences basic to this investigation provide an organization useful in high school classes.
2. Adolescents are interested in this way of studying nutrition, and since it is in line with the objectives of education one feels confident that such opportunity for study should be provided in the high school curriculum.
3. Reference materials, texts, and illustrative material for use in this unit are as yet relatively inaccessible.
4. Some participating teachers felt, it seems wisely, that some use should be made of the movie films now available related to the study of nutrition.
5. Pupils have expressed frequently that there is more connection between this study and their daily lives than any other phase of of the curriculum. Other phases of the curriculum should be made from functional.
6. Anecdotal records give evidence that pupils need concrete experiences such as animal experimentation, use of respiration apparatus, analysis of ash content of foods and the like, to gain interests, understandings and appreciations capable of functioning in their daily lives.
7. Biology teachers should accept responsibility for instruction of adolescents about the relation of food to their physical wellbeing.
8. Opportunities and experiences which will make prospective teachers alert and responsive in adapting the curriculum to the needs of adolescent boys and girls should be provided during the teacher-training period.
9. More evidence is needed as to the extent to which pupils integrate classroom experiences, and as to methods of teaching which facilitate such integration.
10. This study has shown how materials of vital importance to boys and girls can be so organized and taught that they function in their daily lives. It seems that other problems closely related to human welfare such as personal hygiene, safety, control of disease, sex, recreation, and psychology might yield fruitful results if studied somewhat after the pattern used in this investigation.

TEACHER-MADE VISUAL AIDS

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One presupposes that teachers are familiar with the available standard sets of materials for distribution from a central station such as the Museums or departments of Visual Education. In the larger school systems slides, films, pictures, and other equipment are available and most helpful for teachers of all grade levels, whereas in the small school systems the supply of certain types of visual aids and equipment are often somewhat limited. Whatever the situation may be there are still ways by which the pupils may have the benefit of certain visual materials.

WHY TEACHER-MADE MATERIAL?

The demands made upon teachers to find and use illustrative materials has led them to search for sources. They are conscious of the excellent sets available from the local museums or the state distributing centers but the teacher often needs material that meets a specific local problem. She can not always wait until the material is finally standardized and ready for circulation. Then, too, she may wish to supplement the standard sets.

The materials she prepares may not be as good from the point of view of the photographer but she is more familiar with it and hence can make it more worth while to her students.

TRAVEL AS A SOURCE

People are traveling more today than ever before in the history of our country. The pupils return from a vacation trip with questions and observations which are beyond the teacher's experience unless she too has traveled to a considerable extent. Teachers are realizing this situation and are availing themselves of the opportunity to travel. During these periods of travel one has an opportunity to get first-hand information and materials for classroom use. Teachers are beginning to realize more and more the value of a camera on such trips. A picture of Indian Chief Heavy Breast, of Snow-capped Mt. Rainier, of Alaskan Canneries and the like, taken by the teacher, have a significance difficult to rate. The element of interest more than compensates for any lack of quality photographically.

Recently I heard a teacher give an illustrated lecture on South America before a group of elementary teachers. She had visited several South American countries the last summer. She had taken pictures with her own camera, and supplemented her list with post cards she purchased enroute. For her talk she used the regular contact prints in an opaque projector. She knew what she needed for her class work, and proceeded to secure it. Her lecture was illustrated with excellent pictures and specimens.

Another teacher took a motion picture camera along on a tour of the Pacific Southwest. Pictures of the white tail squirrel in the Kiabab forest, of the rock formations of the Zion and Byrce National Parks, of the desert plants and animals were useful for both science and geography lessons.

Alaska, our only remaining frontier! Here one sees the mighty glaciers, majestic Mt. McKinley, the coastal forests, the tundra, the gold mines, the Indians, the totem poles, the salmon, the big game animals, the wild flowers—all these are intriguing subjects for both still and motion pictures.

WEEK-END TRIPS

The week-end trip frequently takes one into new areas rich in the application of

scientific principles. In some cases, the actual specimens may be collected. In other instances one can obtain pictures to illustrate units dealing with trees, wild flowers, rocks, crops, farm animals, etc. On these week-end trips we have visited forests with virgin stands of timber, bogs, power plants, bricks plants, potteries, the mounds of prehistoric man. Any and all of these are fertile sources for pictures. One teacher has built up a series of local farm pictures which she obtained by frequent visits to the country during one season.

Ohio produces a considerable amount of maple sugar and syrup each year. About the time the farmers have finished boiling sap, several of the towns in the heart of the region hold a festival or fair. Here one can easily obtain pictures of the process of making maple sugar, and, from the exhibits, draw conclusions concerning the progress in improving the methods of the industry.

Unless one has made inquiry it is difficult to realize the large percentage of teachers who own some kind of camera. In some cases the would-be photographer has used the camera once or twice, and then it remains on the shelf to collect dust. In other instances, the teacher had taken a variety of pictures, but was satisfied with the ordinary photo-finisher contact print. Frequently such a collection has a wealth of material which remains to be made into large prints or lantern slides.

The motion picture camera—both 16 mm. and 8 mm, in the hands of the beginner, has produced some material that can be used in the classroom. Unfortunately, the cost of motion picture equipment has been a "hurdle" for teachers.

However, the innovation which is having the greatest influence on teacher-made visual aids is the miniature camera. Cameras which may be classed as miniature are made to take film sizes from 1 x 1½ inches to 2¼ x 3¼ inches. These compact devices are used by both amateurs and professionals. With such models, as the Leica, the use is universal. With shutter speeds up to 1/1000 of a second, and lenses rated at f2 and fl.5, pictures may be obtained under most difficult lighting conditions.

Candid "shots" of children in action, portraits, photo-static copy work, landscapes, close-ups of flowers, minerals, etc., are all easily possible with the better made precision miniature camera.

Any of the foregoing mentioned equipment should yield enlargments 8 x 10 or 11 x 14 inches. Such prints, if purchased, would be costly, but if teachers make them, they can be produced at nominal cost. At the same time, the teacher may be following out a hobby or developing a new one.

During last summer, a group of teachers made a set of enlargements of animals of the zoo, which they are using in the classroom this year. The possibilities for using such enlargements are numerous.

Likewise, lantern slides can be made from any of the good negatives. If one has to have the lantern slides made they are rather costly, but for the teacher interested in the subject of photographic technique, the black and white slide can be made for a few cents—(12 to 14 cents).

One assumes that teachers are generally familiar with the pupil-teacher-made slide or window transparency. These can be made by making sketches on etched glass slides, or on parchment paper. Still another type of slide is made by typing on cellophane and mounting between glass slides.

The use of the larger transparency (8 x 10) is beginning to be realized by teachers today. An inexpensive box containing light is used to show these large positives in lower grades. Another way to display them is to hang them in the window.

COLOR

The most significant recent development in photography is natural color. By these

new processes the field of teacher-made visual aids is greatly enlarged. Kodachrome film produces, clear, sharp brilliant pictures. It is purchased in daylight loading magazines and the procedure is about the same as for black and white film.

Any one who can take good black and white pictures can obtain good results with Kodachrome. One needs to use care in selecting subject matter, composing the picture, and thus make an exposure as nearly accurate as possible.

Remove the exposed film from the camera and mail to Rochester. The film is processed and returned ready for use. It is this feature of processing (without additional cost) that makes a color film almost universal among teachers. Nearly every one is willing to learn how to expose the color film and from there on the work is done. When the film is returned it can be used without any further work as film strip in a projector. There is one danger of using it as film strip: mainly, one is likely to scratch the emulsion and ruin the picture.

Even though it requires a little work it is better to mount the views separately and protect them from scratches and dust. The individual pictures are cut from the strip and placed between two cover-glasses and bound with cellophane tape.

The minature camera is especially valuable for color work since one type of color film is not yet made for larger sizes. Then too, the minature camera will continue to be useful for natural color pictures since the smaller size of color film helps keep down the cost of color pictures. Kodachrome transparencies of 1 x 1½" can be shown as extremely large pictures on the screen for use in the large auditorium without any grain and without any loss of brilliancy. One wonders why it is necessary to consider the larger size negative material in Kodachrome.

With a little support and encouragement many teachers are glad to help make pictures and transparencies for classroom use. Last summer a small group of teachers produced a motion picture entitled, "Animals of the Zoo". The motion pictures were in both black and white and natural color. The "Location" was the local park and was of especial interest to the children. Some members of the group had never before attempted to use the motion picture camera. The results were gratifying.

Another group made a series of enlargements and lantern slides from miniature camera negatives.

The subject matter included animals of the zoo, trees, and wild flowers.

Still another group is working on Natural color. Children's activities, science specimens, trees, flowers are topics of interest to these teachers.

I agree that the standard sets of slide should be of the highest quality obtainable but I still maintain that there is excellent material that can be produced by teachers. I am aware of the fact that not every teacher can make good enlargements and transparencies but I have seen excellent prints and positives made by the amateur. They were equal to anything that can be produced commercially.

If teachers are lacking in a knowledge of photography and the technique for producing prints and transparencies, would it not seem necessary to offer courses designed to meet this need? In fact some colleges have been offering courses in photography, and the movement is rapidly spreading.

If the college course is not possible, a local club might be organized under competent leadership.

THE CONSTRUCTION OF A SCALE FOR THE DETERMINATION OF THE SCIENTIFIC ATTITUDE "SENSITIVE CURIOSITY"

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The purpose of this investigation is to construct a device suitable for measuring the effects of science instruction upon the scientific attitude "sensitive curiosity". It is in no way concerned with the content of science courses or with the methods of instruction in such courses.

The definition of an attitude as a "mind set", a predisposition to act in accordance with a definite pattern of behavior, is accepted for the purposes of this study. It is assumed, however, that it is possible not only to have an attitude toward definite situations but also to possess a generalized attitude that will modify reactions to many situations. Curtis'[1] description of the attitude of sensitive curiosity concerning reasons for happenings "coupled with ideals 1. Of careful and accurate observation, or of equally careful and accurate use of data previously collected by others; 2. Of patient collecting of data; 3. Of persistence in the search for an adequate explanation" was accepted for use after an analysis and evaluation of the literature on scientific attitudes.

METHOD

A modification of Thurstone and Chave's[2] method of Equal Appearing Intervals was used in this study. In their measurement of the attitude towards the church, opinions about the church were submitted to 300 persons who were asked to sort these opinions into eleven groups with respect to the degree of appreciation or depreciation of the value of the church which the opinions seemed to show. The degree of appreciation or depreciation between each of the eleven groups of items was to appear equal to the judges sorting the opinions. The median rank for each item was then determined and that value used as a scale value for the item. The items were then submitted to a test for ambiguity and the most suitable items were selected for the scale. The result was a scale of forty items with objective attitude values in a form that could easily be administered and objectively rated.

The modifications of Thurstone's technique deemed desirable for the purposes of this study were:

1. This study used a nine point scale instead of the eleven point scale. The range of the nine point scale was considered to be sufficiently large. It also made possible the use of a slightly different technique in scaling the items.
2. Expert judges were used to scale the items instead of laymen. Due to the specialized field with which the study dealt, it was assumed that the judgments of experts in that field would be more valuable than those of laymen.
3. A smaller number of judges was used. Because of the restrictive criteria for the determination of the experts, it would have been difficult to have obtained a large number of competent judges.
4. The scale values and the measure of ambiguity were determined by statistical formulae rather than by the graphic method.

In any system of measurement there must be a unit of measurement. The unit for this scale is an equal appearing interval conforming to the law of comparative judgment described by L. L. Thurstone[3] and is derived in the following manner:

[1] Curtis, Francis Day. "A Determination of the Scientific Attitudes." *Journal of Chemical Education* 3: 920–921; August, 1926.

[2] Thurstone, L. L., and Chave, E. J. *The Measurement of Attitudes.* Chicago, Ill.: The University of Chicago Press, 1932.

[3] Thurstone, L. L. "The Law of Comparative Judgment." *Psychological Review* 34: 273–286: July, 1927.

Consider a line, AB, as extending between two extreme degrees of the possession of the attitude of "sensitive curiosity".

A——————————————————B

Shows low degree of the attitude	Shows high degree of the attitude

Now examine this opinion. "No attempt should be made to explain natural happenings." It is quite evident that the person making this statement had very little curiosity about his surroundings. This opinion should be placed somewhere to the left of the center of the line. But the statement, "Whenever I see something new I always try to find out what it is," indicates that the person making it is curious about his surroundings. Such a statement should probably be placed somewhere to the right of the center of the above line. Thus, if a person accepted or rejected a series of such statements, each having a definitely determined location between two extreme degrees of the possession of the attitude, those he accepted would give an indication of the degree to which he seemed to possess the attitude of "sensitive curiosity."

To locate the placement of these items on the scale and to determine the width of a scale unit, a group of opinions of this type is submitted to a group of judges who are to place them in separate categories. Every category should, in the opinion of these judges, be separated from every other category by the same degree of attitude variable. A frequency distribution of the placement of each item by these judges can then be made and the median placement of each item can be determined. This median will serve to locate each item in the scale.

The final outcome will be a series of statements allocated along line AB. As Thurstone [4] says, ". . . the apparent difference between any two opinions will be equal to the apparent difference between any other two opinions which are spaced equally far apart on the scale. In other words, the shift in distance represented by a unit distance on the base line seems to most people the same as the shift in opinion represented by a unit distance at any other part of the scale. Two individuals who are separated by any given distance on the scale *seem* to differ in their attitudes as much as any other two individuals with the same scale separation."

Seventy-one statements of opinions deemed by a small group of graduate students meeting in a seminar in science education to reflect varying degrees of the attitude "sensitive curiosity" were selected from various sources. The following criteria were arbitrarily established to aid in the selection of the opinions:

1. Each opinionated statement should contain only one thought.
2. The vocabulary used in each opinion should be as simplified as possible.
3. Each item should express clearly the situation it represents.
4. The opinions should represent varying degrees of the attitude so that all parts of the scale would contain items.

These items were arranged on a sheet and submitted to fifty pupils in eighth grade science at Scottsbluff, Nebraska, to insure that, as written, they were suitable for use with pupils in the junior-high school. Certain items were modified as a result of this preliminary trial.

The items were then submitted to twenty experts in the teaching of science who had previously indicated their willingness to cooperate in this phase of the study, and who met the following criteria:

(a) The judges had to have a membership in the National Association for Research in Science Teaching.

(b) They had to be actively participating in research in areas closely related to the scientific attitudes.

The directions to these judges follow:

(a) The 71 enclosed slips contains statements of opinions which seem to indicate that

[4] Thurstone, L. L., and Chave, E. J. *The Measurement of Attitude.* Chicago, Ill.: The University of Chicago Press, 1929. p. 18.

the persons making the statements possess varying degrees of the scientific attitude which involves a "sensitive curiosity concerning reasons for happenings." These opinions are to serve as items for a scale to indicate this attitude.

(b) As a first step in making this scale to be used to indicate the attitude, "sensitive curiosity," a number of experts are needed to sort these slips into nine piles. You have previously indicated your willingness to serve in this capacity.

(c) You are given nine envelopes with letters on them, A, B, C, D, E, F, G, H, and I. Please arrange these before you in regular order. On envelope B put those slips or statements of opinion the acceptance of which, you believe, expresses the lowest degree of "sensitive curiosity." On envelope E put those expressing an average degree. On envelope H put those slips which express the highest degree of sensitive curiosity." After these slips have been reduced to three piles, separate each pile into three more piles according to the varying degrees of the attitude within that pile. That is, the pile on envelope B will be divided into A, B, C, that on E into D, E, F, and on H into G, H, I.

(d) This means that when you are through sorting you will have nine piles arranged in order of value-estimate, from A, the lowest, to I, the highest.

(e) Do not try to get the same number in each group. It is unlikely that they are evenly distributed.

(f) The numbers on the slips are for identification purposes only and have no significance with the piles.

(g) You will find it easier to sort them if you look over a number of slips, chosen at random, before you begin to sort.

(h) When you are through sorting, please place the slips in their corresponding envelopes and return to Lon Edwards, Principal, Junior High School, Scottsbluff, Nebraska.

DETERMINING THE SCALE VALUE OF THE ITEMS

In order to give the scaled opinions a numerical value, an origin was arbitrarily chosen at the low end of the scale and given a value of 0. The opinions that had been placed in the lowest group, A, were then given a value of 1, those in the next group, B, 2, and so on until those in the highest group had been given a value of 9. A frequency distribution was then made by tabulating the number of times each item had been placed in each group. For example, the tabulation for the item "Whenever I ride in a car, I wish I knew more about how it works," is as given below.

The median for each of the 71 items was computed from the ratings given it by the 20 judges by using Odell's [5] formula plan. The median rank of the above item is 6.5 on the basis of a nine point scale.

Regardless of how carefully a statement may be written it will not mean the same to all individuals reading and rating it. Even if a statement did have the same meaning to all the raters, it would not necessarily elicit the same response from all of them. If neither the meaning of an item nor the reaction pattern of the judges varied for a particular item, the distribution of that item would be very narrow and within one category. The scale value would be the mid-point of that category and the

Item Number	Frequency of Placement									Total	Median
	1	2	3	4	5	6	7	8	9		
1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	0	2	6	2	4	5	1	20	6.5

[5] Odell, C. W. *Statistical Method in Education*, pp. 77–78. New York: D. Appleton-Century Company, 1935.

quartile deviation of judgments would be very small. As an item tends to give different meanings to different judges and as the judges' evaluations of the meanings vary, the distribution of ratings for the item spreads into a number of categories. The scale value of the item is the point about which the distribution is centered. The quartile deviation increases with the spread in distribution. The distribution of an ambiguous statement tends to be bimodal, giving a large quartile deviation. Thus, the Q-value becomes a criterion of ambiguity or clarity of meaning. The amount of disagreement in the judgments among the judges with respect to each item was determined by computing the quartile deviation of the ranks of judgments on each item. The median value and the Q-value for each of the 71 items are indicated in Table I.

Any item in this list having a computed Q in excess of 1.11 would be one upon which the agreement would be no closer than if the item had been rated by a group of inexpert judges. All such items were discarded. Of the remaining fifty-five items, sixteen with values greater than the mid-value of the scale together with sixteen items possessing values smaller than the mid-value were selected to form the completed scale on the basis of the following criteria:

1. The Q-value for any item should not exceed 1.11.
2. Both the upper and the lower range of the scale should be represented equally well.
3. A scale value should be represented by one item only.
4. Where a choice is to be made between two items of the same scale value the one with the lower Q-value should be used.

An estimate of the reliability of the scale values was obtained in the following manner. The mean Q-value for the thirty-two items selected for the scale was .63. Since the scale values of the opinions are the medians of their distributions on the nine point scale the probable error of these scale values may be determined by the formula $\text{P.E. Md} = \frac{1.25\ Q}{\sqrt{N}}$.[6]

This formula applied to these data gives ±.17 scale units as the average probable error of the scale values. For example, if a pupil's attitude rating as obtained by this scale was 4.7 the chances are 51 in 100 that this pupil's rating would be somewhere between 4.53 and 4.87. The completed scale with directions for checking follows:

A SCALE FOR THE DETERMINATION OF THE SCIENTIFIC ATTITUDE OF SENSITIVE CURIOSITY CONCERNING REASONS FOR HAPPENINGS

DIRECTIONS: The items of this scale are opinions or statements that have been made by other people. Its purpose is to see how your thoughts and actions on these items compare with those of other people. Read each item carefully.

If you can entirely agree with a statement, and can accept it as being the same as one you might make in a similar situation put a check (√) in the blank at the left of it. If you *can not* completely agree with the statement, and *can not* accept it as one you might make in a similar situation do not check it. Check *only* the ones you can *really* accept as your own.

Example:—If I found an insect I couldn't name, I would ask someone what it was. If you really accept the statement above as being the same as one you might make about a similar situation, put a check in the blank. If you cannot accept it as one you might make in this situation, do not check it. Remember, you are not to decide whether the statement is right or wrong, but whether it seems to express opinions and ideas that are the same as yours.

——1. I don't know much about how a radio works, but I'm completely satisfied in just listening to it.

[6] Garrett, H. E. *Statistics in Psychology and Education.* New York: Longmans, Green & Company, 1937.

TABLE I

THE SEVENTY-ONE ITEMS WITH THE MEDIAN AND Q OF EACH ITEM AS DETERMINED FROM THE RATINGS GIVEN IT BY THE TWENTY EXPERT JUDGES

Median	Q	Item Number	Items
1	2	3	4
6.5	1.30	1	Whenever I ride in a car, I wish I knew more about how it works.
1.3	.59	2	I enjoy listening to a radio, but I have no desire to know why it works.
6.1	1.00	3	I have often wondered why there were buttons on the sleeves of men's coats.
8.0	.78	4	When I see an alarm clock, I want to tear it apart to see what makes it run.
3.8	.62	5	I would have liked to have seen the eclipse of the sun but I didn't have a smoked glass.
4.8	.65	6	I'd like to know why a radio works if it weren't so complicated.
7.8	1.25	7	If I wore glasses, I would want to know how they affected my eyes.
7.7	1.20	8	If I had an alarm clock that wouldn't run, I would like to take it apart to see what was wrong with it.
4.8	.70	9	Every time I open a lock, I wonder how it works. If I had time, I would examine one to find out.
6.5	1.25	10	When I see people wearing glasses, I always wonder why so many people need them.
6.3	.90	11	I have often wondered why some stars twinkle and others do not.
1.4	.56	12	I have seen no value in scientific research.
7.0	1.30	13	If I were getting glasses, I would be more interested in the way they improved my sight than in what they cost.
4.7	.60	14	I often wonder why plants need water to grow, but I never have time to find out.
1.6	.50	15	I don't know much about how a radio works, but I'm completely satisfied in just listening to it.
6.7	1.10	16	John says that prohibition has been a complete failure, but I should like to know why he thinks so before I will believe him.
4.9	.90	17	The other day I broke a mirror and then had a stroke of bad luck. I wonder if breaking the mirror had anything to do with it.
2.8	.60	18	When my parents or teachers tells me something, I quite often accept it as true without thinking much about it.
5.2	1.17	19	I have often wondered why men offer their seats to ladies when there isn't room for all to be seated.
2.5	.68	20	I see no particular reason why "ain't" is wrong.
1.3	.50	21	I do not care to know about evolution.
8.1	.65	22	It says in our textbook that water will evaporate when the weather is cloudy. I have also read that the sun "draws water." If water evaporates on a cloudy day, there must be something else besides the sun "drawing water" connected with its evaporation.
6.7	.77	23	Our teacher said that flies should be kept away from food. I have tried for two days to find out why but haven't found the answer. Guess I'll have to ask the teacher.
6.0	1.05	24	Alice is thin and pale. She should go to a doctor to find what is the matter with her.
5.0	.90	25	I read that some toothpastes were hard on the teeth. If I had time, I would try to find out whether this statement is true or not.
6.5	1.50	26	I have often wondered why a fog stays near the ground part of the time and then rises.
4.9	.62	27	I have often wondered why smoke doesn't always go up. If I had more time I would try to find out.

Median	Q	Item Number	Items
1	2	3	4
6.2	.85	28	I have often wondered why the trunks of some pine trees are twisted in a spiral.
5.7	1.46	29	I have often wondered why men walk on the outside when walking with women.
6.3	1.12	30	I like to know how my school work can be improved.
1.8	.79	31	I don't like to have people find fault with the work I do.
1.3	.48	32	If I had done something that was wrong and later had an accident, I would be satisfied with the explanation that the accident happened because I had done a wrong deed.
1.1	.30	33	No matter how many people would criticize an act of mine, I would believe I was right and they were wrong.
2.2	.70	34	The only reason for things going wrong for me in school is that I am not feeling well.
1.8	.60	35	A successful man is "self-made."
7.8	.60	36	Advertisements say that gum chewing is healthful. I can't believe it until they tell the reasons why it is true.
6.5	1.40	37	I would like to know why an only child is quite often a spoiled child.
7.1	1.13	38	When I have bad luck, I can usually find the reason for it.
6.0	1.67	39	At present there seems to be no good explanation of how life began on the earth but one will be found sometime.
1.7	.65	40	The life-span of people is increasing. The reasons for this will never be known.
8.5	.77	41	If I found a beetle that neither my parents nor my science teacher could identify, I would send it to the director of the Museum of the State University to find out what it was.
4.5	1.02	42	I should like to go to the Akeley Wing of the Museum of Natural History and see the African animals in their natural setting but subways are too crowded today.
1.6	.72	43	Peter says that he minds his own business and never pays any attention to things that are happening while he is walking along the street. I think this is a good plan to follow.
1.2	.49	44	I would prefer to believe that the rainbow has a pot of gold at its end. It is so much more romantic that way.
1.4	.60	45	I don't want to see an explanation for all natural happenings.
1.3	.50	46	I'm satisfied to take things as they come and leave the explanation for some one else.
2.0	.62	47	Why go to so much trouble to find out if this explanation is really true. I saw it in a book and that's good enough for me.
8.7	.50	48	It's always a good practice to try to analyze all of the things you do that don't come out as you had planned, to see where and why they didn't work.
8.7	.50	49	When we get a new book in our library or class room, I always try to get to it as soon as I can to see what it is about.
6.5	1.12	50	Admiral Byrd's trip to the Antarctic was very successful because he found the answers to many scientific questions.
6.6	1.17	51	When it is impossible to get first hand information about a problem, it is perfectly all right to use data previously collected by some one else.
2.3	.69	52	Heart disease takes the greatest toll in human deaths in the United States. It's too bad nothing can be done about it.
2.3	1.00	53	My friend and I found a 10 cent can of food we had never heard of on the shelves of a store. He bought it just to see what it was. I think that is a foolish way to spend money.
1.9	.40	54	It's better to ask the teacher for the answer to a question than to look it up for yourself.

TABLE 1—*Continued*

Median	Q	Item Number	Items
1	2	3	4
8.3	1.10	55	It is reported that Charles Darwin waited twenty-six years after he finished collecting his facts to report his Theory of Evolution. He most certainly was justified in spending that much time in checking his facts to insure that they were correct.
8.9	.27	56	When I see something new, I always try to find out what it is.
8.7	.50	57	June is usually a rainy month in the Central Rocky Mountain region. If it took me two months to find out why, I would think the time was well spent.
2.3	.93	58	Thousands of dollars are spent in research laboratories each year trying to find the answers to such questions as, "What is life?" I think the money should be better spent for something else.
1.1	.31	59	If I lost my job, I would never try to find out why.
2.4	.82	60	People were not living on the earth at the time life began, so any explanations about its beginning will have to be guesses and therefore of no real value.
4.9	1.20	61	If I found an insect I couldn't name, I would ask some one what it was.
1.3	.59	62	Einstein was foolish to spend so much time making up his theory of relativity.
7.6	.75	63	The government should finance scientific expeditions that are seeking to solve some of the present questions of science.
7.9	.45	64	There are still many unsolved secrets in nature. I think man should keep trying to solve them until the answer is finally found.
1.0	.26	65	No attempt should be made to explain natural happenings.
4.6	.71	66	Timber squirrels have been seen destroying birds' nests and killing the young birds. I would like to know why they do this if it weren't so much trouble finding out.
2.0	.90	67	If I had read that when it is going to rain a pitcher of cold water "sweats," I would believe it to be true.
8.2	.86	68	Miss Jones, our science teacher, never has time to explain to us why things happen as they do. I wish she would take more time and show us "why" as well as "how" they work.
5.1	.67	69	John Galloway, a farmer, planted his potatoes in the light of the moon while Bill Perkins, who lived just across the road, planted his in the dark of the moon. If it weren't so much work, I'd like to plant at both times sometimes and see if the moon does affect them.
6.8	1.33	70	A person will be a better driver of his car if he knows the reasons why the different parts of the car work as they do.
1.1	.29	71	I think that scientific investigation should be discouraged. The answers to all important questions have been found.

——2. When my parents or teachers tell me something I quite often accept it as true without thinking much about it.

——3. When I see an alarm clock, I want to tear it apart to see what makes it run.

——4. Timber squirrels have been seen destroying birds' nests and killing the young birds. I would like to know why they do this if it weren't so much trouble finding out.

——5. No attempt should be made to explain natural happenings.

——6. Miss Jones, our science teacher, never has time to explain to us why things happen as they do. I wish she would take more time and show us "why" as well as "how" they work.

——7. Heart disease takes the greatest toll in human deaths in the United States. It's too bad nothing can be done about it.

——8. I have often wondered why some stars twinkle and others do not.

——9. I often wonder why plants need water to grow, but I never have time to find out.

——10. I have seen no value in scientific research.

——11. Advertisements say that gum chewing is healthful. I can't believe it until they tell the reasons why it is true.

——12. It's better to ask the teacher for the

answer to a question than to look it up for yourself.

——13. It's always a good practice to try to analyze all of the things you do that don't come out as you planned, to see where and why they didn't work.

——14. Why go to so much trouble to find out if this explanation is really true? I saw it in a book and that's good enough for me.

——15. It is reported that Charles Darwin waited twenty-six years after he had finished collecting his facts to report his Theory of Evolution. He most certainly was justified in spending that much time in checking his facts to insure that they were correct.

——16. The life span of people is increasing. The reasons for this will never be known.

——17. I see no particular reason why "ain't" is wrong.

——18. John Galloway, a farmer, planted his potatoes in the light of the moon while Bill Perkins, who lived just across the road, planted his in the dark of the moon. If it weren't so much work, I'd like to plant some at both times and see if the moon does affect them.

——19. I have often wondered why smoke doesn't go up. If I had more time I would try to find out.

——20. The only reason for things going wrong for me at school is that I am not feeling well.

——21. I would prefer to believe that the rainbow has a pot of gold at its end. It is so much more romantic that way.

——22. When I see something new, I always try to find out what it is.

——23. I would like to have seen the eclipse of the sun, but I didn't have a smoked glass.

——24. People were not living on the earth at the time life began; so any explanations about its beginning will have to be guesses and therefore of no real value.

——25. Alice is thin and pale. She should go to a doctor to find what is the matter with her.

——26. There are still many unsolved secrets in nature. I think man should keep trying to solve them until the answers are finally found.

——27. I have often wondered why the trunks of some pine trees are twisted in a spiral.

——28. Our teacher said that flies should be kept away from food. I have tried for two days to find out why but haven't found the answer. Guess I'll have to ask the teacher.

——29. I think that scientific investigation should be discouraged. The answers to all important questions have been found.

——30. If I had done something that was wrong and later had an accident, I would be satisfied with the explanation that the accident happened because I had done a wrong deed.

——31. A successful man is "self-made."

——32. Every time I open a lock I wonder how it works. If I had time, I would examine one to find out.

Item Number	Scale Value	Item Number	Scale Value
1	1.6	17	2.5
2	2.8	18	5.1
3	8.0	19	4.9
4	4.6	20	2.2
5	1.0	21	1.2
6	8.2	22	8.9
7	2.3	23	3.8
8	6.3	24	2.4
9	4.7	25	6.0
10	1.4	26	7.9
11	7.8	27	6.2
12	1.9	28	6.7
13	8.7	29	1.1
14	2.0	30	1.3
15	8.3	31	1.8
16	1.7	32	4.8

Figure 1. Key For The Scale For Determination of Scientific Attitude of Sensitive Curiosity Concerning Reasons for Happenings

The scale and key may be used in the following manner. Assume that the pupil endorses items 3, 9, 13, 22, 25, and 28 in the scale. The values of these items as indicated in figure 1 are 8, 4.7, 8.7, 8.9, 6, and 6.7 respectively. The total of these values is 43. Since the pupil endorsed 6 items the mean value of his responses is 7.2. This pupil would, in the opinion of these twenty experts, possess the attitude of "sensitive curiosity" to the degree of 7.2 upon a scale with a range from 1 to 9 with respect to the particular items that appear in this scale.

Norms for pupils based upon the number of semesters spent in science classes are being determined. The writers recognize, (1) that the scale does not have as even a gradation of items as is desirable, (2) that this scale may indicate the exhibition of this attitude for these particular items, and (3) that the criterion established

for determining the extent of agreement of the judges on any item to be used in the scale was arbitrary.

It is, however, a first attempt to apply this particular technique to the evaluation of these socalled "intangible" outcomes of science instruction. It is hoped that subsequent study and refinement of such scales may provide more adequate instruments for the evaluation of attitudes.

THE CLASSROOM AS A MEANS OF STIMULATING INTEREST IN SCIENCE

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One of the most vital phases of science teaching in the junior high school is the use of the science classroom as a means of stimulating interest. Only too often science teachers complain that pupils are not interested in science, that they come into the classroom and sit listlessly through the hour, that they are bored. Frequently a glance into their classrooms would show little more than four walls broken only by windows and blackboards, places which certainly would stimulate no child to interest and attention. Studies have shown that young people as well as adults are definitely affected either pleasantly or unpleasantly by their surroundings and it is to be expected that there will be a reflection of this feeling in the pupil's attitude toward the work that is carried on in the room. This is true to such an extent that a bleak, bare, uninteresting room may produce a sufficiently negative effect on pupils so that even good teaching fails to offset it and to arouse enthusiasm. A science classroom is a room to be lived in and as such should be pleasant. It is a room in which science is taught and should therefore be fitted so as to gain attention and interest in this field. The science teacher who does not use her classroom to its fullest possibilities is missing a golden opportunity.

First and foremost, it should be borne in mind in equipping a classroom that it is a science room and therefore all its fittings, whether on the walls, bulletin boards, or tables, must announce this fact to the most casual passerby. No other field of teaching is so rich in equipment which can tell such fascinating facts to the pupils coming into the room. A well planned science classroom will serve as a silent salesman for the subject, for it will attract pupils' attention to scientific materials, will arouse their interest in its problems, and will stimulate them to serious thought and questioning.

BULLETIN BOARDS

The bulletin boards of a science classroom serve a three-fold purpose: (1) they are interest getting devices; (2) they serve as places to illustrate the class work through pictures; (3) they are places to exhibit outstanding work of the pupils. In order to have bulletin boards function as they should in these three ways, it is necessary to take special pains with every item that is placed for exhibition. The board as a whole should have an attractive appearance with its pictures or other materials arranged in some sort of pattern. Only too often we see bulletin boards on which all the large pictures are on one side and all the small on the other, or perhaps only half of the board is covered with an odd assortment of pictures unevenly placed which gives one—and also the pupils—the uncomfortable feeling that they had been allowed to land wherever they pleased. If you do not arrange the boards yourself, but

have pupils do it, it is usually necessary to take a little time to train them in arranging exhibits satisfactorily. The time spent more than pays for itself in results. Whenever possible, mount pictures on colored paper, the color for each exhibit uniform. The bright colors improve the appearance of an exhibit tremendously, as well as attract the pupils' attention. Use different colors for different sets of pictures, thereby changing the color scheme of the room each time an exhibit is changed.

A second important point to be observed is to have the materials on a bulletin board deal with one topic only, thus making each board in the room a unit in itself. In this way, pupils are able to pass from picture to picture and build therefrom a small related body of knowledge. They are not confused by the unconnected facts which result from an heterogeneous collection of material.

A further successful device has been found to be the use of bulletin board headings which indicate the nature of the exhibit. These should be large enough and of heavy enough printing or writing so that they may be read from any point in the room. A series of illustrations which has received no attention whatever in a room will frequently attract many pupils after a heading announcing the subject is placed above it.

It is not always necessary that the material used on a bulletin board pertain directly to the work being done in the classroom. Various science units do not lend themselves well to illustration. There are always other science subjects that may be brought to the attention of pupils through pictured material which may be used to keep the board in operation during such a period. I have found it interesting and profitable to keep one board for just such outside topics, always, however, making sure that the subject is of a scientific nature.

Some space should also be set aside for exhibiting current scientific pictures and articles cut from newspapers and magazines. If a regulation bulletin board cannot be spared for this, a square of wood may be used to which such material may be tacked. This material need not, of course, be mounted, nor is any special arrangement possible since the object is to pin up as much as possible. If attention is given to this board, it will not be long before pupils will bring to class more material than there will be room for. Both exhibits of this nature and of the unit type must be changed frequently. Newspaper clippings should never stay up more than a week while unit exhibits should be changed every two weeks at the longest. When left up over a long period of time, they cease to exist as far as the pupils are concerned. They become merely a covering on the wall that has no meaning nor interest.

Bulletin boards, however well arranged, attractive and interesting, will not completely sell themselves. A technique of using them must be developed. Unless attention is definitely drawn to them, pupils frequently come into a classroom day after day without realizing that a new exhibit has appeared. A check was made on this by asking several groups of ninth grade pupils to write down, without looking, the subject and content of an exhibit that was on a bulletin board in the room. Out of the entire number of 135 pupils, only 17 were able to describe the exhibit in detail while approximately 50 more could tell something about it. This means that the majority were utterly unconscious of the fact that there was something to be seen. Thus it is obvious that it is necessary to bring the pupils' attention to focus very pointedly on the exhibits. Time must be taken to discuss the contents of an exhibit or it has little value.

A second device that has been found satisfactory with groups of higher intelligence is to list a series of questions about the topic being illustrated. These are then posted in the center of the bulletin board together with library references which may

be used in finding the answers. This, then, furnishes a basis for discussion.

EXHIBIT MATERIAL

In addition to the bulletin board type of illustrative aids, there is a vast amount of material available for exhibition. Any science teacher is able to find a surprising number of natural science specimens in her own back yard. A Saturday morning in the open yields dozens of different varieties of insects, land plants, water plants and water animals. Pet shops, children's museums and friends are further sources of loan material. Construction of an insect cage, a terrarium, or a balanced aquarium may easily be made a class project. For the physical sciences, equipment set up for experiments, microscopes set for use, magnifying glasses placed over various objects, all serve to gain the attention, interest and curiosity of pupils. Some of these, of course, cannot be handled. As many as possible should, however, be placed in the open where they can be picked up and examined. Interest in an object expresses itself most naturally through both seeing and handling and provision should be made for this in so far as it is possible.

Again, however, these things do not sell themselves. They must be accurately labeled so that the child is left in no doubt as to what he is looking at. A small block of wood with a slit one half inch deep across the top serves excellently as a holder for an index card on which is written the name of the object and some interesting facts about it. Even the ordinary goldfish bowl becomes a center of interest when a card is placed on the glass cover which indicates the life history and habits of the animal. Much more intense interest can of course be aroused when tropical fish are raised in the room since their habits are more fascinating than the lowly goldfish.

Children's own contributions should always be an integral part of the room exhibitions. They should be placed where they can be seen by everyone and should always be labeled with the owner's name in addition to other facts concerning the object. Care should be taken that pupils' contributions are kept in good condition so that they may be returned to the child undamaged. Frequently it is possible to develop an exhibit of material through the activities of a class. Building materials and clothing materials are easily collected in this way in connection with the units of work on these topics.

There is also the teacher's personal source of material. Everyone has materials at home which may at times be brought for special exhibition. A point that must be strictly observed with respect to this is, however, to be sure the material is of a scientific nature. Many objects that are beautiful and cherished in a home do not fit in a science classroom.

In addition to the exhibit materials brought in, space must be provided for the outstanding pieces of work prepared by the pupils—booklets, posters, special reports, models. A bulletin board is an ideal place for many of these. If this is not available, however, a narrow wooden rack, three or four feet long with nails inserted every six inches may easily be made. From these nails, the booklet type of material can be suspended with string. a longer length of string for each row, thus taking care of a large number.

BLACKBOARDS

Science rooms frequently are equipped with more blackboard space than is necessary. Nothing is colder and more unpleasant to look at than a great stretch of black emptiness. This may be made more interesting and valuable by using it for colored chalk illustrations of the various subjects under consideration in the classes. Almost every class has an artist who would like nothing better than a chance to use that space. For illustrations which you wish to use throughout the semester, use poster paint which can easily be washed off but will not smear when rubbed accidentally.

An oversize thermometer drawing, a chart on which the readings of thermometer, barometer and weather forecast may be kept from day to day is an example of this type of blackboard use.

PLANTS

A science room is not complete without a variety of plants. As large an assortment as possible should be grown. If window boxes are available, a more pleasing arrangement is possible than with the use of flower pots alone. In using boxes, plant the entire pot without removing the plant. In this way, they may be easily taken up and transplanted in the spring. A small chemical garden attracts a vast amount of interest and leads to definite scientific knowledge. Bulbs which flower later in the year add to the pleasantness of the room. Colored hanging bowls filled with ivy, flower pots painted red, yellow, orange and green, window boxes painted a light rather than a dark green, all help to develop a feeling of pleasure within the child and make him much more ready and willing to work.

The pictures on the walls of a science room should with few exceptions have some scientific connotation. Care should also be taken not to use too many of them. Just as a bare room has a poor effect on pupils, so too does the overcrowded room. There must be breathing space and a happy medium must be found somewhere between the appearance of a barn and an overcrowded hall closet.

It may sound as though a room program of this sort requires a tremendous amount of work. It does at the beginning of the year. Once established, however, it is not difficult to maintain since the changes that are made from time to time are small and do not all have to be made at the same moment. Furthermore, the effect of a pleasing, colorful and interesting room on the pupils who spend an hour each day there makes the work of keeping it in order a satisfaction rather than a chore.

THE LECTURE-DEMONSTRATION METHOD *versus* INDIVIDUAL LABORATORY WORK IN CHEMISTRY *

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From a study of the development of chemistry we find that the first organized science in the schools of England was in 1872, and it was not until 1902 that credit was accepted for chemistry on the same basis as for other courses. The situation in England was approximately paralleled in the United States. It is a matter of record that for many years chemistry was not associated with culture, but with some low form of manual dexterity and nauseous smells.

* Paper presented at the Association of Science Teachers of the Middle States, Atlantic City, N. J., November 26, 1938.

Between 1900 and 1925 chemistry made a stupendous growth in all parts of the world. The number of scientific articles increased to an almost unbelievable number. New journals sprouted forth nearly every year. The application of chemistry to medicine, agriculture, metallurgy, farming and many other trades and professions resulted in the subject of chemistry being suddenly brought to the foreground. The World War greatly advanced chemical industry in the United States. The hundreds of new achievements had their effect upon the youngsters in schools. They wanted to know something about chemistry and a

sudden demand for chemistry was felt in both colleges and high schools.

The teaching of chemistry soon proved to be expensive. Large laboratories were needed. A large budget was needed for supplies many of which, in most cases, went down the sink. The teacher student ratio in the sciences has never been particularly favorable from the cost comparison. Science teachers cannot put as large a group of students through the mill as can teachers of some other subjects. Thus, the cost of teaching chemistry to large groups of students was such that it was obvious that attempts would be made to cheapen these teaching costs.

Paralleling the rapid advances in chemistry was to be noted the amazing growth of teachers' colleges, teacher training courses, and a much greater emphasis upon the technics of teaching.

A plausable solution to the high cost of teaching chemistry was thus suggested. Chemistry might be given as a demonstration course. There was really nothing new in this suggestion for chemistry, like all other sciences, was first taught by the demonstration method. Chemistry got its start in the eyes of the public from the marvelous lectures given to the public by the outstanding scientists of the 18th and 19th centuries. Kings, queens, and noblemen, as well as the general public attended these lectures to be awed as well as educated. Many of the scientific advances of the past can be traced directly to the inspiration received by some individual at one of the public lectures.

There are some educators who show, either by their spoken words or lack of support of the laboratory sciences, that they have little if any faith in the laboratory method of teaching beginning sciences. Some would be satisfied to see the beginning laboratory science given as a demonstration course to large groups of students. It is only fair in discussing the laboratory method and the demonstration method to raise at the outset the following questions: What is the laboratory method?, What is the lecture demonstration method?, and, What are the aims of those teaching chemistry? Aims of chemistry teachers have been formulated time and again and there are several articles dealing with this subject in the *Journal of Chemical Education*. Some educators place the emphasis upon the scientific method and some upon factual material.

Plutarch summarized all the arguments against the informative method when he said, "The child's mind is not a vessel to be filled but a fire to be kindled."

Fowles* summed up the argument against those desiring to place all of the emphasis upon the scientific method when he stated what is a well-known fact to all of us who have had any teaching experience, namely. "Some pupils are incapable of acquiring the scientific habit of thought and others to whom an intellectual process is irksome offer a mental resistance to the efforts of the teacher however persuasive he may be." Accordingly, he urges, "that for the majority of pupils the instruction should be about chemistry and not deal with the philosophy or technic of the science."

The aims of the chemistry teacher were stated very concisely at the New York meeting of the American Chemical Society by Professor Schlesinger, of The University of Chicago, when he said that we are attempting to train students to see, to think, and to do. I am willing to accept these three objectives of Scheslinger as the broad and general objectives of all science teachers.

Harry Woodburn Chase in *American Mercury*, for November, 1934, emphasized his case against the beginning chemistry teacher when he stated "The usual elementary science courses, for example in chemistry or biology, are taught as though each beginner were taking his first feeble step toward the PhD. They stress laboratory manipulation and technical detail rather

* Lecture Experiments in Chemistry. P. Blakiston's Son and Co., Philadelphia, Pennsylvania.

than the broad underlying principles of the science as a part of the equipment of the cultured layman."

That there exists a definite difference of opinion concerning the merits of the lecture demonstration versus the laboratory method of teaching chemistry is shown by the numerous published papers on this subject. In December, 1934, I conducted an experiment on opinions by the questionnaire method—one hundred questionnaires were evenly distributed among college chemistry teachers and industrial chemists. Among the questions were the following:

> "There appears to be a tendency among some of our colleges and universities to introduce lecture-demonstration courses in beginning chemistry with the elimination of laboratory work by the student. Whom do you consider most responsible for this change? Do you believe in this method of teaching chemistry?"

The answers most frequently listed for the first question were: (1) professors of education, (2) college administrators, and (3) economic conditions.

In answer to the question, "Do you believe in this method of teaching chemistry?" 16 per cent replied *yes*, and 84 per cent, *No*.

Such comments as the following express the opinions of both sides:

"No; each chemical problem is an individual case and must be treated as such. The student realizes this only when in actual contact with the experiment."

"No; every student should have some training in the technic of some experimental science and in the scientific method. The movement probably comes from men who have had no genuine scientific training."

"No; does not train a student to do a thing himself, observe, and draw conclusions from his own observations."

"No; I believe that students learn more by actually doing a thing than by seeing it done no matter how far superior to their efforts the demonstration may be. However, we should, I think, cut down on the amount of laboratory work required in general chemistry and emphasize more the type of work and the understanding of what the student is doing. Rather than sacrifice laboratory training, I believe in graduate students' teaching."

"Yes; such a very small percentage of beginning students follow up chemistry; those who do not, lose the laboratory knack and knowledge gained in laboratory very quickly. Specializing students can make up the very necessary laboratory work later."

"Yes; expensive laboratory work for the mass of credit-hunters is a waste of good public funds. Of course, we would not give the demonstration-lecture courses alone to the real chemistry and medical students."

What Is the Laboratory Method?

There is a much wider variation in the so-called laboratory method of teaching than is commonly recognized. This is true of both college and high school teaching. At the college level one finds that the laboratory work varies in the following general ways:

(a) Following of standard laboratory-manuals—such as Holmes, Smith-Kendall and McPherson and Henderson.

(b) A great emphasis upon the physical and quantitive aspects of chemistry—such as the laboratory work at California Institute of Technology.

(c) Emphasis upon the preparation of a substance and utilization of it in a later experiment rather than simple test tube reactions which are dumped in the sink at the end of the period.

(d) Emphasis upon qualitative analysis. In many cases the laboratory work in the second semester is all qualitative analysis.

(e) Special technics such as the treating of chemistry from an historical concept, repeating famous early experiments.

Beginning courses in most colleges and universities are accompanied with both lectures and recitations.

There are no data available which indicate whether the beginning laboratory courses in chemistry in colleges and universities are being appreciably superseded

with demonstration courses or not. Some schools have adopted both non-laboratory chemistry courses, and survey science courses and have later dropped them.

Laboratory work in the high schools is even more varied than at the college level. Conferences with men in state education departments indicate that questionnaire studies of the procedures used in teaching high school chemistry can only lead to replies of doubtful value. Thus, if the state education requirement specifies that credit for chemistry will only be given providing the high school course includes laboratory work, it is obvious that laboratory work will be claimed for the course given at the school. The school principal cannot afford to state that the chemistry course is not up to the standards specified by the state education requirements.

I have approached this problem time and again from another angle. Each year I have between 300 and 400 chemistry students taking general chemistry at Syracuse University who have received college entrance credit for high school chemistry. By personal interviews with these students I have found that the high school chemistry course although accepted as a laboratory course may fall under numerous classifications:

(a) The standard high school course with recitations and individual laboratory work.

(b) A course patterned after college courses which includes lectures (with or without demonstration), recitations, and individual laboratory work.

(c) Recitations plus laboratory work—two students work together in the laboratory.

(d) Recitations plus laboratory work—more than two students work together in the laboratory.

(e) Recitations plus demonstrations, in which the students perform the experiments before the class.

(f) Recitation plus demonstrations. The instructor does all the demonstrations and the students write up the results of the experiments in their notebooks.

(g) Recitation plus a very limited amount of demonstration work, the teacher telling them what would happen if they had the chemicals and the equipment with which to do the experiment.

(h) In some so-called "progressive schools", chemistry is taught on the group project basis or some modification of the project basis.

We must all recognize the extreme difficulty in getting statistical data on the type of high school course which is given in chemistry. I can think of several questions which if answered would throw considerable light on this subject.

1. It would be interesting to know how many of the 20,000 members of the American Chemical Society had a high school laboratory course in chemistry, how many had a demonstration course, how many had no chemistry in high school.

2. It would be interesting to know what correlation exists between grades in freshman college chemistry and the type of chemistry course which the student had in high school. (Of course we know from thousands of grades that students with no chemistry in high school receive poorer grades in college chemistry if placed in classes with students who have had high school chemistry.)

3. Another question on which an answer is needed pertains to the training of the high school teacher. How many high school instructors in any state are teaching chemistry without having had a single course in chemistry?, With only one demonstration course?, With only one laboratory course?, With two courses?, With three courses?, With four courses?, and With more than four courses? Does it make any great difference in the later work of the student in college? In general it has been my experience that chemistry teachers feel that they are not satisfied with their own teaching of chemistry in high

school unless they have had at least three or four courses in chemistry.

In selecting the technic which any teacher uses in teaching it is obvious that the selection will depend upon the ability of the teacher to produce results by use of the method. There are some teachers who can never hope to become successful by using the demonstration method. If the instructor is shy on poise or ability to speak clearly, or gets fussed in laboratory manipulation, then demonstrations are sure to be unsuccessful. Such a teacher may be very satisfactory in individual student consultation.

It was the general opinion at the American Chemical Society meeting in New York in 1935 that there was absolutely no evidence that the demonstration method of teaching was in any way superior to the laboratory method. It appears impossible to find reports of educational research which give the nod to either method. General references are to be found in the literature stating that the demonstration method is superior. Thus, in 1935, W. W. Knox, stated, "It is evident that the experimental data we possess point definitely to the superiority of the demonstration method as far as those outcomes that may be measured by the ordinary written tests are concerned". He further states, "I am convinced that the abandonment of the laboratory method at the present time would mean a degeneration of science teaching in the secondary schools". He further states "The question might well be raised, which method stimulates maximum pupil interest?"

Some few years ago I had a good idea for a control experiment on the demonstration method of teaching college chemistry. But it didn't work. I selected 30 students who had high school chemistry and had received a grade of "A" in college chemistry and put them in one section for the second semester. At the first meeting of the second semester I proposed that we divide the class in two groups and one group would do the regular laboratory work and the other group would be taught by demonstration. I would do all of the laboratory experiments as demonstrations. In order that each student be satisfied with his program I proposed that each student write his name and the group desired by him on a sheet of paper. Then I would separate them into two groups. I collected the papers. Can you guess the result? Twenty-nine students wanted to continue in the regular laboratory course and one was willing to be taught by demonstration. At first one's reaction might be that after my lecture demonstrations the first semester, the students were ready to call it quits. A previous check had indicated that they thought my demonstrations were satisfactory. But they wanted the experience of doing the work for themselves. I still remember the comment of one student which was "Someday, I hope to be a surgeon. I want experience in doing things for myself."

As the situation stands at the present time it is apparent that the merit of these methods of teaching cannot be measured unless the tests given bring out the true value of laboratory work. Further, some means of measuring student interest must be obtained. To illustrate an attempt at student interest as obtained by the two methods, suppose that you try this on two groups of students which meet at the same hours but on different days in the laboratory. Scheme the laboratory work in such a way that the topic of identification of common substances around the house has been brought up and raise the question of having five bottles known to contain flour, starch, sugar, salt and baking soda and assume that the labels have fallen off the bottles and you want to put the right label on the right bottle. Call the students together and start to do this as a demonstration and time the demonstration so that

you just get started when the period ends and it is time for students to leave. Just remark well there goes the bell and stall around to see how many are interested in completing the experiment. Repeat with another group stating the problem and giving each student some of each substance. Give them time to get just nicely started before the bell rings. Which group will have more interest in completing the experiment?

It is my opinion that all chemistry offered in the secondary schools should include laboratory work. Too much of the secondary school training at the present time treats the child's mind as a vessel to be filled. The average college freshman is sadly lacking in capacity to do individual work which shows definitely that the past training of these students has not placed sufficient responsibility for individual work upon the student. The fact that such students have passed regent and college board examinations means only that the students have been trained in memorizing the answers to questions. Memorizing of factual material alone does not constitute an education.

I am just as firmly convinced that any college or university which does not make it possible for all of its students to take laboratory science courses if they so desire, is not offering a true college program. At the college level no student should be required to take a survey course or a demonstration course to fulfill a science requirement if that student prefers to take a laboratory science. A demonstration course may be selected as a matter of preference by some students who are convinced in their own minds that they do not want to do laboratory work.

These statements do not imply that I am opposed to demonstrations in chemistry teaching. Far from it. Every possible aid to the subject may be used. I have pointed out that the blackboard for drawings, lantern slides, projections and movies are among the teaching tools of today.*

There is no room in our present educational system for the lecture which serves only to give students an opportunity to transfer the professor's lecture notes to their notebooks. The lecturer might as well have his lecture notes mimeographed and passed out to the students. Lecturers in general chemistry need not suffer from such criticisms, for the opportunity is theirs to make all of their lectures of the demonstration type. Further it is an excellent practice to have some point for discussion in the recitation period which can be clarified by use of a single demonstration.

There are different technics which may be used in any demonstration. No doubt, the most common one follows closely the procedure used by the minister with his sermon when he said "I tells 'em what I'm going to tell 'em, then I tells 'em and then I tells 'em what I's told 'em". Such a method makes of the student a silent non-thinking member of the party. This should not be encouraged.

In the ideal demonstration a student would raise a specific question such as, "What would happen if salt and silver nitrate are mixed?" or, "How could one distinguish by chemical tests between salt, sugar, flour, starch and baking soda?" The students would then suggest the experiments to be conducted and with suitable guidance experiments bearing upon the question should be performed.

As a third method student participation in the demonstrations may be used and as thus used serves a substitute for laboratory work.

A fourth technic which may be employed is that of the silent demonstration, and at times it can be made very effective. It consists of stating the field of experimentation and then carrying out the actual manipulations without making any com-

* Albert L. Elder. *Demonstrations and Experiments in General Chemistry.* New York: Harper and Brothers (247 pages).

ments. The student is thus confronted with the problem of doing his own thinking and selecting the significant points from what is observed. The big objection to this procedure is that the movies have spoiled the true value of the technic. One usually finds that the movie goer can do little more than tell you the title of the movie two days later, a visual picture being nothing more than a sensation of the moment. To use the silent demonstration effectively I have found that the experiment must be repeated at least once.

Demonstrations may be used to avoid the hazards of laboratory work. Time and again laboratory accidents could have been avoided had the students been sufficiently impressed with the dangers involved. As science teachers I am sure that you are aware of the growing movement to make schools responsible for accidents in the laboratory. Every teacher should be aware of the legal regulations governing laboratory accidents in his state. If it is held in your state that it is better to leave uneducated than to risk any harm to the student in the process of education then laboratory work must not be done without suitable warnings and precautions being made perfectly clear in advance. For dissemination of the dangers of laboratory work demonstrations are extremely helpful.

In conclusion, I wish to state there is a place for demonstrations wherever a course in chemistry is given. Demonstrations are but one of the tools of the teacher, and every available tool must be used in teaching this ever expanding subject in a fixed time to students who are probably no more efficient in grasping new ideas than were the students of one thousand years ago.

THE SCIENCE-LABORATORY LIBRARY

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The science teacher does not labor alone, his co-workers are those other science teachers who have not laid up their knowledge in a napkin, but have put it in attractive form in books, that he who runs may read. The very fact that people all over the country are becoming library conscious indicates that the work of these co-workers is being appreciated.

The science teacher must know the available books in his field, and be able to help the children under him to become independent users of these books. Mr. J. T. Giles strikes the key-note in this work, when he says,

> "The chief use out-of-school John and Mary are making of their science is in their reading. We can start them to doing this better than we have in the past. It is not necessary to have an extensive science library in the school, although this is desirable. Out of school the pupil must choose and find his own books. He should have guidance and practice in school in doing just that thing." [1]

It is true that much can be gained in the way of knowledge from demonstrations and individual experiments, but it is folly to imagine that we can find out all there is to know about any one thing. Therefore we must not disregard the work and the findings of those pioneers who have blazed the science trail ahead of us and found out things concerning the truths we are seeking.

The science library should be an integral part of every science laboratory. While it need not be extensive it should be well

[1] Giles, J. T., "Reorganization of High School Science—Laboratory or Library," *Education*, 56: 385–446; March, 1936.

FIGURE 1.——The Library-Corner of the Science Laboratory of the Training School, East Texas State Teachers College, Commerce.

chosen, well organized, and conveniently placed and accessible. The books should be indexed and catalogued and the records kept in a filing case. Books taken from the library should be signed for in true library fashion. It has been proven that children learn very readily to look after these details themselves although it is a great help to have an older student take the responsibility.

As to the laboratory I would suggest the following set-up. There should be a large well-lighted room equipped with tables and movable stools. There should be placed in it cabinets for museum articles and filing cases for special materials. The room should also contain a sink and running water as well as gas and electric attachments. In one corner should be found the science library.

The interest in the care and preservation of the books is enhanced when the children have a pride in it due to ownership. This may be brought about by allowing them a part in the development of the library and the privilege of donating books personally. The care of these books then becomes the problem of the children rather than of the teacher. Miss Carpenter [2] gives some helpful ideas on this.

Just how this library is to function and how the work is carried on from day to day may best be explained by giving the history of a single day in and out of our own science laboratory. While the incidents vary, the actual interest and use of the books is a continuous thing. The accompanying photograph (Figure 1)

[2] Carpenter, Helen S., "What is Back of Efficient Reference Work in an Elementary School Library," *Wilson Bulletin*, Vol. 10, September, 1935.

shows the library corner of the science laboratory in the Training School of the East Texas State Teachers College, Commerce, Texas. On the left two boys from the seventh grade are making crystals. With a chemistry book taken from the shelves they are carefully following the details of the process. On the floor are seated two little girls from the sixth grade who have come in to settle a question that has arisen in their room concerning the difference between limestone and marble. Apparently they have found the answer in a volume of *Compton's Encyclopedia.* A girl from one of the high school classes is looking up in the *Handbook of the Heavens* some information concerning sunspots. She tells me that she saw some while in Dallas, Texas, during a dust storm last week. Near her stands a student-teacher supervising the room. In this way he becomes more intimately acquainted both with the children and their work. The college student seated at the desk is the librarian *protem.* He is checking out a book to a little girl who wishes to take it home to prove to her brother that she was right when she said, "Stars do not fall."

This is the history of one day last week. When I arrived in the morning I found two boys seated by the door. They chided me on being late, they have been waiting, so they say, since seven-thirty. They explained to me that the day before they went to the field to study birds. They saw a sparrow which James insisted was a Field Sparrow while Bill insisted it was a Chipping Sparrow. The picture in *Birds of America* seems to settle the dispute. Just as they were leaving the room on the last lap of the last bell James tells me that, "Red-tail ate the mouse Ernie gave him and is ready to be set free." Red-tail is an injured hawk that Ernie has been caring for. Much research has been done to find out what Red-tail would like to eat. I realized that some changes must be made in the lesson planned for the day in the Biology class.

In a few minutes Bobby entered from the Manual Training room next door in search of a book on electricity. He chose one, signed for it and departed. In a moment he returned saying, "This is not the one I was looking at yesterday, it had a diagram showing how the wiring should be done." He made the exchange and departed. Next three students from a college class entered. They were seeking information concerning some simple experiments to put in a "Unit" they are working up. They must have help as they have never had any science courses.

Before long the bell rang for the next class. The students in Biology came in and for a few minutes apparent disorder reigned as they checked out a book, looked up some last minute information for a report, and settled two important disputes with authentic information. We then appointed a committee to personally conduct the expedition to free Mr. Red-tail. Work was assigned to the others and a student teacher left in charge. The committee of seven then piled into a car and we went to Ernie's home after Mr. Red-tail. Billy kindly undertook to carry him saying, "I am really his friend only he doesn't know it." We set him free in a woodland about three miles from town. Harold took a picture of him just before he sailed away. We then made a list of the birds seen and hastened back as we were anxious to find out which is really larger, a Western or an Eastern Meadowlark. Teacher might be wrong about it. (She was.)

During the noon hour I noticed that the bird books were spread out over the tables and that much discussion was going on as to the verification of the Eastern and Western Meadowlarks. The Song Sparrow and the Savannah Sparrow likewise were carefully checked in all the books and the fact that we had seen them both was settled.

Later on the Sixth Grade Class came in at their period and placed their rocks for our Rock Collection on the tables and were

soon busily engaged with the work of identification and classification. This required the use of both books and chemicals. The *Field Book of Rocks,* by Loomis was most popular. *Everyday Science Projects,* by Smith was eagerly poured over as to how to test the rocks.

Mary Ann and Bess from the Second Grade dropped in to find out about a caterpillar and triumphantly departed with a book on Butterflies and Moths. Some Eighth Grade boys came in to study the barometer. Something seemed to trouble them, but apparently they found out what they wanted by the combined help of the instrument in hand and *Everyday Problems in Science,* Pieper and Beauchamp. I did not offer any help.

The science library in our laboratory now numbers two hundred and fifty volumes. It has been gotten together here a little and there a little. We have always had the full help and cooperation of Mr. E. H. Watson, Director of our Training School, who has made several important additions, *Compton's Pictured Encyclopedia,* and *Junior Brittanica* being among the number.

We have gotten together all the text books available. These we find very valuable as they have definite information in usable form. The Parent-Teachers have materially helped us out by providing a certain fund for the particular purpose of providing books. Various school clubs have given us books and the children themselves have personally donated books.

The various book companies have helped us out and by visiting the booths at state and national meetings and setting forth the object of our laboratory-library we have received a large number of new, attractive, and interesting books on scientific subjects.

Our work just now is to find out how many worth while books on science we do not have and then try to get them. We find that the booklet prepared by Webb[3] has been of much help along these lines. We are proud and rightly so, of our Laboratory-Library.

[3] Webb, Hanor A., "The High School Science Library for 1936–37," *Peabody Journal of Education,* 12: 57–71; September, 1937.

A PLAN TO MEET THE NEEDS OF THE STUDENTS AT GRANT COMMUNITY HIGH SCHOOL THROUGH BIOLOGY CLASSES *

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The large high school makes provisions for guidance in a number of essential fields. Many of these are equipped with one or more full time guidance workers, detailed records, and the facilities to assist many of the individual students in a variety of ways. In the typical small high school of two hundred students or less we are faced with an entirely different picture. Even a part-time guidance worker is seldom found, records are inadequate, and criticism is likely to come to the regular classroom teacher who attempts to guide students. It is difficult to convince the average small high-school administration that anything but the subject matter in the various courses needs to be taught. Occasionally, the "problem child" who is either maladjusted or backward is assisted by the principal or the teacher. It is generally taken for granted that the student who is superior in his scholastic grades has no personal problems. This attitude is entirely erroneous, and guidance, if it is to be of any value, should reach all the students.

For some time the writer has felt that guidance was needed by the students at Grant Community High School, and that some provision should be made to provide it through the system as it existed, without an increase in expenses. An attempt was to be made to provide guidance through the regular biology classes. In preparation for this work the writer enrolled at Northwestern University for three consecutive summers. At these times guidance and science were both studied, in an attempt to coordinate the two, and emerge with a definite plan of attack. Each summer a course of study was worked out in detail, only to be revised and changed during the following school term. Finally, as partial fulfillment of the requirements for the Master's degree, a plan which seems to be quite adequate has been devised. This plan in addition to meeting the usual biology requirements, meets many of the needs of students, as the reader will see.

In an attempt to discover the needs of his students, the writer made a thorough study of the school and community. Three different methods of approach were employed, and after three years of careful study something tangible from which to work was evolved. A detailed study of the community and school was carried on by the students under the supervision of the instructor. This provided much useful information, and at the same time was enjoyed by the students. Much of this work was done by committees, some members of which became so vitally interested that they continued the project during vacations. The problems investigated were concerned with such phases as occupations, community resources, entertainment facilities, church membership, and a variety of related subjects.

In addition to this, all the students were individually interviewed in an attempt to find more information which could be used. Several students were privately interviewed every day, and after about three months all had been questioned. By this method many additional facts were brought to light.

Not being entirely satisfied with the results, the writer used another method of investigation. A questionnaire of two hun-

* Abstracted from a Master's Thesis by the author, Northwestern University, 1938.

dred questions was prepared and given to the students to answer. This was done under careful supervision, and after instructions as to the nature of the questions were given. The questions were based upon the sociological and psychological interests, vocational interests and abilities, economic status of the home, leisure time activities, and moral and religious interests.

After a careful tabulation of all the results of these three types of investigation, the most outstanding needs of the students at Grant Community High School were analyzed. It was found among other things, that the community was unique in many ways. The most typical occupation was of the summer resort type. This consisted of supplying boats and bait, furnishing rooms and board, conducting excursion boat trips, operating taverns, hotels, and dance halls. It was found that the average Grant Community High School student was of the sophisticated type, with a lack of moral and religious training.

The writer was then ready to develop a course of study to fill the needs of the students. This was done after a careful investigation of all available materials. Copies of the newest secondary-school biology textbooks were obtained from the publishers, and examined in an attempt to discover the materials most useful for the course. It was decided that no single text would meet the requirements, but that several had chapters which could be utilized. The school, therefore, provided several copies of about ten different texts, which were kept in the classroom and loaned to the students. In addition to this, mimeographed materials were handed out to the students covering topics not covered by the textbooks. Outside speakers, movies, and field trips provided additional information.

As an example of the plan, the writer submits herewith a part of his course of study. This part deals with the problem of reproduction.

1. Reproduction (Asexual)
   - A. Fission.
     - 1. Transverse. (Paramecium)
     - 2. Longitudinal. (Euglena)
   - B. Budding. (Yeast)
   - C. Regeneration. (Planaria)
   - D. Vegetative Reproduction. (Geranium)
   - E. Grafting. (Apple)
   - D. Tubers. (Potatoes)
2. Reproduction. (Sexual)
   - A. Conjugation. (Paramecium)
   - B. Germination. (Pollen grains)
   - C. Egg and Sperm.
     - 1. Fish propagation. (External Fertilization)
     - 2. Frog propagation.
     - 3. Reptiles. (Internal Fertilization)
     - 4. Birds. (Internal Fertilization)
     - 5. Egg laying mammals. (Platypus)
     - 6. Marsupials. (Opposum)
     - 7. Higher mammals. (Rat)
     - 8. Human reproduction. (From this point the work takes on a more personal aspect.)
       - a. The glands of the body.
       - b. Endocrine glands.
       - c. Sex glands and organs.
         - 1. Abuses to the glands of the body.
       - d. Approach to manhood and womanhood.
       - e. The discipline of the appetites.
       - f. Love.
       - g. Marriage.
       - h. Modesty.
       - i. Chastity.
       - j. Venereal Diseases.
         - 1. Cause.
         - 2. Types of venereal diseases.
         - 3. Prevention.
         - 4. What to do if infected.
       - k. The proper attitude toward sex.

Similar outlines have been worked out by the writer on other vital problems, and these are taken up in detail in the course of study. It is the writer's firm conviction that guidance can be accomplished through classes in biology, and hopes that these suggestions may be of value to other teachers of the subject.

Abstracts

GENERAL EDUCATION

SYMPOSIUM. "Safety Education." *The Phi Delta Kappan* 21: 161–224; January, 1939.

Among the topics considered in this symposium on safety education are: (1) psychological approach, (2) the utilization of community agencies and resources, (3) trends in bicycle safety, (4) teaching old dogs new traffic tricks, (5) training for leadership, (6) teacher training, (7) high school, (8) elementary school, (9) high school curriculum, (10) the shop teachers part, and (11) source materials.

—C.M.P.

SYMPOSIUM. "Vocational Guidance and Teaching as a Man's Job." *The Phi Delta Kappan* 21: 241–272; February, 1939.

This is a timely symposium, as more attention is now being given to vocational guidance than at any preceding time, especially at the college level. —C.M.P.

SYMPOSIUM. "The University High School Study of Adolescents." *University High School Journal* 17: 67–116; December, 1938.

This is the first part of a report of an investigation sponsored by the General Education Board and directed in the interests of guidance service and curriculum development. The University High School is located in Oakland, California.

This report gives the basic philosophy, organization, and cultural and institutional setting of the school. A case study of one pupil is reported in some detail. —C.M.P.

PRESTON, CHARLES E. "Science and the Changing Curriculum." *The High School Journal* 31: 158–165, 181–182; May, 1938.

The factors which are bringing about changes in the high school curriculum through increasing attempts to meet the needs of the varying types of individuals in our schools is discussed. Trends of administration change which seem likely to come, and which are being tried experimentally in some places are seen as (1) making student activities a part of the curriculum, rather than something set apart from the "regular" school work, (2) a general integration of the curriculum with a breaking down of the walls that divided knowledge into artificial compartments, (3) greater use of community resources both "human and physical" and the use of the community as a school laboratory. The implications of these trends to science teaching are then discussed. The major difficulties in the way of moving in the direction of these trends are seen as (1) inflexibility of present programs in terms of hourly class schedules, (2) traditional adherence to subject matter divisions by the teachers themselves, (3) fear and perhaps unwillingness of teachers to change to something new and relatively unfamiliar that will require them to revise their philosophy or habits, (4) the influence of college entrance requirements, (5) difficulties of transportation in connection with trips in the community, (6) possible conservatism of school boards and parents, (7) the absence of shop facilities wherein boys and girls may construct working models, etc.

—O. E. Underhill.

ROLLER, DUANE. "The Role of the Sciences in General Education." *The American Physics Teacher* 6: 244–253; October, 1938.

The article presents the trends in science instruction in the lower division of the college as they are reflected in recent articles and books. The trend is definitely toward survey courses for the non-science major in the lower college. So far the role of the laboratory has not been exactly worked out. There is a feeling that laboratory work should become an integral part of the course. The new course has certain implications for teacher preparation. Such a college teacher must know his subject matter. A teacher of science must be a scientist. He must have intensive and extensive training of graduate caliber and involving genuine research experience, in one of the fundamental sciences.

—C.M.P.

WALLACE, R. C. "The Changing Values of Science." *Science* 88: 265–271; September 23, 1938.

Changes in emphasis are taking place in the values of science. The author states the two following general conclusions: (1) the method and the attitude of science are indispensable for modern life and thought, and (2) not only is education in science necessary, but the young scientist should know something of the problems of the psychologist, the philosopher, the economist, the sociologist, and the statesman.

—C.M.P.

SYMPOSIUM. "Aviation." *Building America* 4: 1–32; October, 1938.

This issue of Building America considers the following questions: (1) How did men learn to use air for transportation? (2) What are the principles underlying aviation? (3) Who uses the air and for what purposes? (4) What difficulties do Americans face in developing aviation? and (5) What can aviation mean to America? —C.M.P.

LIVERMON, RUTH. "The Use of Motion Pictures in an Elementary School." *Educational Screen* 17: 285–287; November, 1938.

An elementary school principal gives some specific suggestions of how films have been used in teaching. The film is made an integral part of the planned teaching procedures. Questions are prepared for the class before the film is shown. Examples are given for the film "Tiny Water Animals". After the showing follows a discussion period. According to the direction of this discussion the film may be shown again immediately, or the pupils may return to the classroom for further study and work, before the second showing is given. Examples of different types of follow-up work in connection with specific films, largely science films, are given. The author considers the use of films of great value if properly used, the chief drawback being the expense of the program.

—O. E. Underhill.

POWER, CARLETON E. "Current Answers to the Question 'What Should the Teacher of Science Know?'" *School Science and Mathematics* 38: 757–762; October, 1938.

A science teacher should have a major of at least 24 hours, a minor of 12 hours, with English and social studies for breadth, and courses in Education for orientation and techniques. Functional understanding of the major concepts of science are recommended as most desirable. —C.M.P.

FOSTER, C. A. "The Correlation of the Marks of Certain High School Subjects With Those in College Physics and College Chemistry." *School Science and Mathematics* 38: 743–746; October, 1938.

The author draws the following conclusions from the study made in the Nebraska State Teachers College at Kearney: (1) The influence of high physics on success in college physics seems to be high, (2) The influence of native intelligence seems to be higher, and (3) The influence of high school mathematics seems to be negligible. Neither high school physics nor mathematics seem to have an appreciable effect on college chemistry, the principal factors being high school chemistry and intelligence.

—C.M.P.

STALNAKER, JOHN M. "Science Examinations of the College Entrance Examination Board." *The Science Counselor* 5: 8, 17–18; March, 1939.

Last June the College Entrance Examinations were taken by nearly 14,000 students in 329 centers. The questions were prepared by a committee of five persons selected from college and secondary teachers. Selected teachers from the science field met in New York City for a week to read the science papers. Last June there were 13 readers in biology for 1903 papers, 24 in chemistry for 2099 papers and 8 in physics for 1007 papers. To obtain consistency data in scoring papers 158 papers selected at random were graded twice, the evaluation sheet of the first reading having first been removed. In chemistry a correlation of .99 was obtained between the two readings; in biology, .97.

Professor Brinkley of Yale, the chief reader in chemistry, believes there is an inadequate emphasis on the factual side. Atomic structure, ionization and equation writing are handled poorly. More accuracy and exactness of statement in the work dealing with definitions, laws, formulae, and equations should be demanded.

Professor Dawson of Yale, the chief reader in biology, believes there is too much "blackboard biology" and insufficient amount of field and laboratory work. There is a need of teachers with a broader background of subject matter.

Professor Waterman of Yale, the chief reader in Physics, believes a high school course should especially impart a genuine knowledge and understanding of broad physical principles and the methods employed in physics in arriving at these principles. Seven aids to instruction are given. —C.M.P.

MANN, PAUL B. "Why Teach Science?" *The Science Counselor* 5: 11–12, 22; March, 1939.

Our most common fault is that we teach for informational content rather than for mental power. In science, the author maintains that sound thinking and deep appreciation are the two chief objectives. —C.M.P.

COERLEIN, KARL F. "Does Laboratory Physics Develop the Scientific Attitude?" *The Science Counselor* 5: 3, 19; March, 1939.

The author raises the question as to whether we can justify a course in physics for the non-science major. His answer is in the affirmative but he believes we must go beyond mere acquisition of knowledge. Socially useful attitudes, realizations, and mental habits must be included. Physics is one of the best courses in which to teach scientific attitudes in such a way that they will continue to control conduct throughout life. To accomplish this we must get away from the present "cook-book" type of laboratory manual and put the student more on "his own".

—C.M.P.

SATTERLY, JOHN. "Observations on the Objectives and the Teaching of Physics in England and Canada." *The American Physics Teacher* 7: 1–9; February, 1939.

The trend in English and Canadian secondary educational field at present is to lessen the specialized teaching of one or more sciences and to encourage the teaching of general science. The author believes this usually means a smattering of all the branches with accurate thinking in none. He would prefer one subject thoroughly well done as giving the better education. Small

classes are better and a good teacher should not be hampered by syllabuses and methods.

Descriptions of courses in physics in Canadian and English institutions of higher learning are included. Work in English schools is more "spread out", which is an advantage. Textbooks are much the same and used in the same way. Students take too many notes in lecture and spend too much time on laboratory note-books.
—C.M.P.

McHENRY, ROY W. "The Physics Problem in Secondary Schools." *The American Physics Teacher* 7: 46–48; February, 1939.

Problems facing the beginning physics teacher include the following: (1) lack of laboratory and demonstration equipment, (2) lessened time, especially for laboratory work, (3) personnel of classes—many pupils lack ability to take a rigorous course in physics, (4) mixing of good and poor students, and (5) teaching personnel difficulties. —C.M.P.

FRIEND, JULIUS W. AND FEIBLEMAN, JAMES. "Society and the Future of Science." *The Social Frontier* 5: 171–173; March, 1939.

Science and society are interdependent. Science requires that society support it and at the same time leave it free to develop as it sees best. Society requires that science produce "miracles" in the shape of practical applications. Science and society must develop along together or both will be doomed. German society failed to keep up with the standard set by German science, and therefore science was destroyed. The advance of science in the past has been directed toward greater specialization. Now a movement has set in toward unification of branches previously considered unrelated. The advance of every science should move in two directions: toward greater and greater analysis, and thus specialization, and toward greater and greater synthesis, and thus generalization. —C.M.P.

FOSTER, LAURENCE C. (Chairman). "Report of the New England Association of Chemistry Teachers' Committee on College Entrance Examinations." *Journal of Chemical Education* 16: 46–49; January, 1939.

The Report states that it is desirable to eliminate from the secondary-school course much theory which is no longer of service to chemistry, even though it is historically interesting; content of the course should be made more flexible. The committee would emphasize very strongly its belief that it is not essential to examine the student upon all topics which have been introduced into the course. The Report appends a syllabus of topics to be covered by college preparatory students upon which the College Entrance Board would base its examinations.
—C.M.P.

McGILL, MARTIN. "The Teacher of High-School Chemistry"; STANFORD, SPENCER C. "The College Instructor"; RAY, FRANCIS EARL. "The University Professor." *Journal of Chemical Education* 16: 22–27; January, 1939.

These are three articles of a series, on "The Chemist at Work."

McGill maintains that a chemistry teacher must read and keep up with the happenings in chemistry; should belong to professional organizations; organize a science club; look with pride upon his laboratory and class work; need not necessarily have a great desire for research in chemistry.

Stanford says the first essential of a prospective college teacher of chemistry is a real enthusiasm for his subject and that he be able to transmit this enthusiasm to his students. He should be honest in his treatment of students, especially in answering questions. He should be as familiar with as many branches of chemistry as possible, possess mental agility, possess a research spirit and be able to cooperate with other members of the department.

Ray discusses the advantages and disadvantages of a university position in chemistry. Various duties are listed and advice is offered the teacher who desires to get ahead.
—C.M.P.

HAHN, H. H. "The Teaching of Home Geography." *The Journal of Geography* 38: 1–8; January, 1939.

Home geography can be and should be a more important subject in the school curriculum than it is now. Activities appropriate to the study of home geography are: (1) making scrap books, (2) taking excursions to observe industries, (3) taking field trips to study surface features and land and water forms, (4) making posters, telling the story of staple products as corn, cotton, wheat, (5) making maps of streets of city, (6) making exhibits, (7) collecting pictures on building materials, (8) keeping a record of weather observations, (9) making a map showing highways and railroads, (10) mapping a farm, and so on.
—C.M.P.

HALL, CARROL C. "Trends in the Organization of High School Chemistry Since 1920." *Journal of Chemical Education* 16: 116–120; March, 1939.

Various committee reports and individual investigations, courses of study and textbooks affected the trends in the organization of high school chemistry. General conclusions are: (1) Early in the period covered by the study, college preparation and the practical applications of chemistry were emphasized, (2) From a purely descriptive arrangement of chemistry materials of an earlier period the topical method of organization was developed, (3) Another significant trend in the organization of high school chem-

istry is the adoption of the scientific method in studying the problems of organization of high school chemistry, (4) The applications of the findings of educational and psychological research to the organization of high school chemistry since 1920, (5) One of the more pronounced trends during the years 1923 to 1927 was that of the articulating of high school and college chemistry, (6) The consideration of the development of the individual student is one of more recent origin and, (7) There are also evidences of a trend to integrate the chemistry course with other subjects in the high school curriculum. The organization of high school chemistry is undergoing a slow process of evolution.

—C.M.P.

WOLINE, R. W. "What Shall I Do With My Exceptional Student?" *Journal of Chemical Education* 16: 18–20; January, 1939.

The author, a teacher of high school chemistry, makes his exceptional students assistants. Standards of qualifications, duties and rewards for student assistants are given, as well as the specific duties assigned them.

—C.M.P.

MEISTER, MORRIS. "For the Science Club." *The Science Classroom* 18: 1; March, 1939.

The science class and the science club are two complementary aspects of a single process sometimes referred to as teaching and learning. In the past the two have been kept separate. Recently they have both been brought into the school; both are the concern of the teacher. Two experiments are described: resisting a magnet's pull and explaining a mirage.

—C.M.P.

SYMPOSIUM. "Teacher Demonstration Material." *The Science Classroom* 17: 1, 4; April, 1939.

The material described was first presented at a meeting of the General Science Teachers Association on January 6, 1939. The following experiments are described: a simple wind tunnel for demonstrating "lift", demonstrating the flow of air around streamlined and non-streamlined bodies, a table-top darkroom—all by Alexander Joseph; automatic sprinkler by Emanuel Holish; demonstrations dealing with photosynthesis by P. F. Brandwein; and a different method for demonstrating the flame tests by Nathaniel Roth.

—C.M.P.

KAUFMAN, CHARLES. "Suggested Activities in the Teaching of Human Behavior." *The Teaching Biologist* 8: 49–54; January, 1939.

The author lists the following aims which can only be achieved by direct study by the pupil of his own reactions: (1) To show the pupil that his sense organs do not always detect stimuli directly, (2) To acquaint the pupil with some of the factors which may cause his reception of stimuli to be inaccurate, (3) To show the pupil how his past learning may influence his future behavior, and (4) to show the value of correct study procedures. The following experiments are described, (1) Reception of sound stimuli, (2) Reception of visual stimuli, (3) Effect of previous experiences on the interpretation of present stimuli, (4) The effect of different degrees of meaning on retention and (5) A study of divided attention.

—C.M.P.

WAILES, RAYMOND B. "Try Your Hand at Organic Chemistry." *Popular Science Monthly* 134: 206–209, 242; March, 1939.

Interesting experiments in organic chemistry—e.g., making acetamide and studying its properties; salicylic acid—are described in this interesting article.

—C.M.P.

ANONYMOUS. "Laws of Science Proved in Easy Tests." *Popular Science Monthly* 134: 210–211; March, 1939.

The following tests are described: (1) Your eye is focused like a camera; (2) Gyroscope resists magnet's pull; (3) Test proves that plants give off oxygen; (4) Liquid exerts pressure upward, too; (5) Piece of glass explains mystery of mirages.

—C.M.P.

WALLINGI, MORTON C. "What Kind of Wood Is It?" *Popular Science Monthly* 134: 212–214, 254; March, 1939.

This is an excellent article describing the use of the microscope in identifying different kinds of wood.

—C.M.P.

WAILES, RAYMOND B. "Fun With Quicksilver." *Popular Science Monthly* 134: 200–203, 244; April, 1939.

This article describes a series of interesting experiments with mercury; suitable for a high school chemistry class or an amateur chemistry student "on his own".

—C.M.P.

WAILES, RAYMOND B. "Chemistry of Fuels Seen in Easy Tests." *Popular Science Monthly* 134: 200–238; May, 1939.

Experiments with coal gas, kerosene, and gasoline are described.

—C.M.P.

ASTELL, LOUIS A. "Significant Aspects of Visual Aids in Chemical Education." *Journal of Chemical Education* 16: 129–133; March, 1939.

The article reviews the more recent developments, emphasizing photography, lantern slide, film slide and film materials.

—C.M.P.

SYMPOSIUM. "Fuel." *Building America* 4: 1–32; December, 1938.

Fuel is discussed under the following topics: (1) fuel—a necessity of modern life, (2) nature

took ages to form fuels underground, (3) for centuries men searched for suitable fuels, (4) Americans rapidly developed their great fuel resources, (5) men and machines mine our nation's coal, (6) America's coal goes from mines to users, (7) how gas—invisible fuel—is made, (8) "oil is where you find it", (9) petroleum is broken up into a number of things, (10) fuel producers face many problems, (11) fuel workers face many problems, (12) consumers want the "best" fuel, (13) government regulation: too much or too little? (14) nations of the world struggle for fuel, and (15) how long will America's fuels last?

—C.M.P.

SYMPOSIUM. "Taxes." *Building America* 4: 1–32; February, 1939.

This issue devoted to taxes discusses: (1) the American people pay many taxes; (2) our people get many services for their taxes, (3) the quarrel over taxes helped bring about America's separation from England, (4) during the last 150 years our nation's taxes have greatly increased, (5) today our government has many tax-raising bodies, (6) why does the government levy different kinds of taxes, (7) property tax: the main source of income for local governments, (8) income, gift and death taxes are levied according to ability to pay, (9) American business pays many kinds of taxes, (10) some taxes are paid directly on purchases by consumers, (11) what is a fair distribution of the tax burden? (12) do all citizens take their tax responsibility seriously? (13) are taxes too high? and (14) taxes in the future.

—C.M.P.

SYMPOSIUM. "Lumber." *Building America* 4: 1–32; March, 1939.

Lumber is discussed under the following headings: (1) lumber—an important American industry, (2) America once had vast areas of virgin timber, (3) America's forests were once an important source of colonial wealth, (4) the forests of the northeast and lake states provided most of America's lumber supply until about 1900, (5) after 1900, America's lumber supply came largely from the south and west, (6) life in the lumber camps, (7) logging requires men with axes, saws and strong arms, (8) there are more ways of logging than of "killing a cat", (9) at the mill logs are changed into lumber, (10) there are more uses for wood than "you can shake a stick at", (11) scientific laboratories aid the wood industries, (12) the lumber industry faces problems of competition, (13) each year we lose vast quantities of timber and lumber, (14) government and private business work to conserve our nation's timber resources, and (15) will America have enough timber for its future needs? —C.M.P.

WATTERS, LESLIE. "Chemistry Exhibits and Projects." *Journal of Chemical Education* 16: 113–115; March, 1939.

The author presents, with illustrations, the home project or outside-of-class-work, in high school chemistry. Such projects have the following values: (1) Allows student to exercise his creative ability, highly motivated by the thought that his work may be displayed before his parents and friends, (2) During the completion of the project the student is able to integrate many of the abilities, skills, and habits previously acquired, (3) Exhibition of the work, as a worthwhile project, provides that satisfaction which is a necessary compensation, (4) The projects furnish, for future class-use, a wealth of illustrative material, compact in form and well organized and (5) The exhibit serves as an advertising agency for the course.

—C.M.P.

SYMPOSIUM. "Iron and Steel." *The Science Leaflet* 12: 1001–1017; March 30, 1939.

This issue of Science Leaflet presents a very interesting story of iron and steel, especially on the early history of the iron industry in this country. —C.M.P.

EDITORIAL. "Sources of Energy of the Sun." *The Science Leaflet* 12: 801–804; February 23, 1939.

This article summarizes a new theory by Professor Bethe of Cornell University that accounts for the enormous amount of energy radiated by the sun. Professor Bethe believes that the energy results from the bombardment of a carbon nucleus by the impact of a fast hydrogen nucleus. The carbon nucleus captures a hydrogen nucleus to form a nitrogen nucleus. This nitrogen nucleus again is bombarded by hydrogen nuclei and finally a helium nucleus is produced and the original carbon nucleus is regenerated. —C.M.P.

SYMPOSIUM. "Copper." *The Science Leaflet* 12: 841–861, 871–875; March 2, 1939.

This issue is largely given over to a discussion of copper, its metallurgy, history, uses, alloys, and properties. —C.M.P.

COTTRELL, F. G. "Complete Control of Plant Growth." *The Science Leaflet* 12: 904–908, 954–957; March 9, March 16, 1939.

This is an article on plant nutrition by the inventor of the Cottrell precipitator. The carbon dioxide factor is discussed at some length and the author states that the carbon dioxide content seems to be relatively fixed and constant. Many factors enter into plant growth and failure to have perfectly controlled conditions in experimental investigations has led to many conflicting results. —C.M.P.

ANONYMOUS. "Human Nutrition." *The Science Leaflet* 12: 950–954, 978–998; March 16, March 23, 1939.

This is the final report of the mixed committee of the League of Nations on "The Relation of Nutrition to Health, Agriculture, and Economic Policy", Geneva, 1937. Phases of the report include: (1) Principles of correct nutrition—vitamins and minerals, (2) "Energy—Bearing" and "Protective" foods for various age groups; (3) The modern science of nutrition and the London Report—(including dietary standards). —C.M.P.

MILLER, CATHERINE. "A Study Plan on Hosiery." *The Science Leaflet* 12: 669–672, 706–708; January 26, February 2, 1939.

This article presents a teaching plan for studying hosiery, presenting practical points on kinds of hosiery, parts of hosiery, determining size of hosiery, points in hosiery buying and care of hosiery. —C.M.P.

WILLIAMS, OPHELIA. "Notes on Housing." *The Science Leaflet* 12: 2–13, January 19, 1939.

This is an interesting article on standards and "buying points" for several household conveniences and appliances: refrigerators, water heaters, air conditioning, ironing machines, washing machines, and so on.

—C.M.P.

PEARSON, T. GILBERT. "Sparrows, Towhees, and Longspurs." *The National Geographic Magazine* 75: 353–376, March, 1939.

This interesting, illustrated article on birds has 43 paintings from life, and 33 life histories and descriptions. —C.M.P.

ABBOTT, ROY L. "Old Mister High-Power." *Natural History* 43: 144–149; March, 1939.

Old Mister High-Power was a black skunk who was an engaging house pet. This delightful story tells about his adventures and untimely end. —C.M.P.

ENGEL, LEONARD H. "Wearing Things Out." *Science News Letter* 34: 170–172, September 10, 1938.

This article tells why National Bureau of Standards scientists destroy all manner of things to see how well they stand wear. Many millions are thus saved the consumer, and the manufacturers are also benefited. Unusual and queer-looking devices and machines are used to make those tests. —C.M.P.

GREY, RICHARD F. "Exposure Meters, II." *Minicam* 2: 22–26, 69–70, January, 1939.

This article describes selection and correct use of photoelectric exposure meters. The author believes that correct exposure is the number-one requirement for good pictures. Illustrated.

—C.M.P.

LINDEY, ALEXANDER. "33 Rules for Enlarging." *Minicam* 2: 50–51, 79–83; January, 1939.

This is a practical list of do's and don't's for anyone doing photographic enlarging.

—C.M.P.

MOORE, W. F. "Interior Photography for the Amateur." *The Camera* 58: 12–17; January, 1939.

This article gives useful hints on interior photography (not portraiture) in lighting, where to place the camera, exposure, and so on.

—C.M.P.

DUTTON, LAURENCE. "The Types of Photographic Papers." *American Photography* 32: 872–833; December, 1938.

This is a discussion of types of printing papers. There is an excellent general list of printing papers giving make and name, type and and method to print by. —C.M.P.

ANONYMOUS. "Print Criticism Department." *The Camera* 58: 54–59; January, 1939.

This is the print criticism department in which good and bad prints are indicated in the more than 20 prints used as illustrations. Much useful information can be obtained through studying the criticisms given regarding the various prints.

—C.M.P.

BOTLEY, C. M. "Peculiarities of Sound Waves." *Science Digest* 5: 26–31; February, 1939.

The first attempt made to calculate the speed of sound was made by Newton in 1686, but due to the fact no account was taken of temperature, the results gave a value 15 per cent too low. Speed was first determined by firing a cannon; now electrical methods are used. Sound was used in locating big guns, and submarines during the World War. Ocean depths are now measured by sound waves. The longest distance sound has been known to carry is 3,000 miles in the Karakatoa explosion in 1883.

—C.M.P.

New Publications

COLLINS, A. FREDERICK. *Photography for Fun and Money.* New York: D. Appleton-Century Company, 1939. 391 p. $3.00.

Another Collins book by America's most prolific science writer, and as usual the practical, hobby aspects of the subject are emphasized. This is an excellent guide book for those practicing photography for fun and for those who use it as a hobby to make money. So concisely is the book written that it is encyclopedic in scope and content. Seemingly, no phase of photography has been left untreated. The chapter headings are: (1) The saga of photography, (2) How the optical image is formed, (3) Lenses and their accessories, (4) The use of diaphragms and stops, (5) How shutters are made and how they work, (6) How the chemical image is formed, (7) The camera and all about it, (8) The accessories you need, (9) Pictorial composition, (10) How to take snap-shot and scenic pictures, (11) How to take architectural and interior pictures, (12) How to take portraits and groups, (13) How to take night pictures, (14) How to take pictures with a miniature camera, (15) How to take press pictures, (16) How to take science pictures, (17) How to take three-color pictures, (18) How to take and project moving pictures, (19) Developing and fixing agents, (20) How to develop and fix plates and films, (21) How to make and finish prints, (22) More about making and finishing prints, and (24) How to copy, reduce, and enlarge pictures.

—C.M.P.

PHILLIPS, HARRY A., COCKEFAIR, EDGAR A. AND GRAHAM, JAMES W. *Agriculture and Farm Life.* New York: The Macmillan Company, 1939. 496 p. $1.48.

The unit plan of organizing subject matter has come a long way and here we find a high school text in agriculture organized in unit form. However it is not organized in problem form. There are exercises and activities under the heading "Something to Do". The fundamental facts and principles of farming are simply, clearly presented. The photographs and illustrations are very good and the book as a whole is an appealing one. Contents are in order of seasonal sequence.

Units are as follows: (1) Farming as an occupation, (2) The farmer works with life, (3) Dairying and poultry raising, (4) The field crops, (5) Horticultural crops, (6) The apiary, (7) Soils and their conservation, (8) Meat and other animal products, (9) Farm power and machinery, and (10) The business of farming.

—C.M.P.

HUDELSON, R. R. *Farm Management.* New York: The Macmillan Company, 1939. 396 p. $1.80.

This is a high school text covering one phase of agriculture—the problem of farm management. Three phases are discussed: (1) Organizing the farm business, (2) Operating the farm business, (3) Farm finance and farm accounts. This book would make an excellent supplementary book for the text "Agriculture and Farm Life" reviewed elsewhere in this issue.

—C.M.P.

BAUER, W. W. AND EDGLEY, LESLIE. *Your Health Dramatized.* New York: E. P. Dutton & Co., Inc., 1939. 528 p. $2.25.

This is a selection of thirty-two radio scripts taken from the health dramatizations broadcast during 1937–1938 by the American Medical Association and the National Broadcasting Company. The original broadcasts received the First Award of the 9th Annual Meeting of the Institute for Education by Radio in 1938.

The scripts have been modified in the opinions of the authors to meet the needs of secondary school pupils for classroom and auditorium productions. The material seems best adapted for use in those schools possessing public address systems. The pupils can realistically play at broadcasting. Each script has a short introduction, pointers for production, standard opening and closing, and directions for music, sound, and action. Each little drama corrects one or more common health misconceptions or unwise health practices. Unquestionably the skits are admirably done. If used as plays or reading exercises to supplement the regular school program they should make a real contribution to the change in attitudes and habits of pupils. Following are a few of the thirty-two titles: Seeing and Hearing Well (12 minutes), Who Chooses Your Doctor (10 minutes), Dietary Foods (15 minutes), Diphtheria (12 minutes), Healthy Hearts (13 minutes), Catching Disease from Animals (20 minutes). —M. L. Robertson.

MASSON, LOUIS T. *Physics Made Easy.* Buffalo, N. Y.: W. Hazleton Smith, 1938. 384 p.

This volume attempts to make physics easy through a direct, informal, simplified presentation and by the use of "Visiographs" and "Graformulas". A "Visiograph" is a pen and ink illustration intended to make visible, graphically, a theory, a principle, or an application of physics. For example, Figure 187 in a section on the human eye shows a cat and the outline of a human head with a moving picture camera, a developing tank, a projector, and an image of

the cat arranged within the head to illustrate by analogy the functioning of the sense of vision. A "Gra-formula" is pictorial representation of a formula, usually with each term of the formula in white letters in a black rectangle, the rectangles being joined together by division or multiplication signs. For example, Figure 130 shows Volts in a rectangle over Amperes and Ohms in two other rectangles and connected to each by a division sign, while Amperes and Ohms are connected together by a multiplication sign.

Testing exercises in the form of essay and completion questions are provided at the end of chapters. A "Pictorial Summary" to be made by students is called for at the end of each chapter. Directions state the minimum numbers of "ideas or principles conveyed" by certain figures in each chapter and asks students to formulate them and write them in their notebooks. The appendix includes a biographical sentence, or more, about each of over fifty famous scientists. The preface states that "The subject-matter meets all the requirements of the New York State Board of Regents and the College Entrance Board of Examiners. In addition, all recent developments of physics, both in the theoretical and practical field, are reduced to simple language and included at appropriate points," a difficult task in a 384-page book with the title of this volume. A chapter on safety is included; there is no section on radio. The thirty-one chapters are grouped into fourteen units in the table of contents, but no evidence of unit organization is found in the text. For example, nothing is included in the text proper to let the reader know when he leaves one unit and enters another, not even a unit title or number.

The "Visiographs", and to a lesser extent the "Gra-formulas", are unique. They should be valuable aids to learning. They involve much reasoning and illustrating by analogy, however, and are subject, therefore, to the misunderstandings and errors of reasoning which may result from imperfect analogies. For example, in chapter XVI, on "Humidity and Engines," the wringing of water from a wet cloth is used to illustrate humidity, but the limitations of the analogy are not discussed in the context.

The physical makeup of the book may seem unsatisfactory to some. No photographs appear among the "illustrations," and the heavy black and white of the "Visiographs" and "Gra-formulas" seems monotonous at first acquaintance. This effect is somewhat enhanced by rather narrow margins on the pages.

The book seems free from errors except such as those which may be read into extremely simplified statements, illustrations which are incomplete, and analogies which lend themselves to multiple interpretations.

—C. W. Barnes.

WRIGHTSTONE, J. WAYNE. "Appraisal of Experimental High School Practices"; Appraisal of Newer Elementary School Practices. New York: Bureau of Publications, Teachers College, 1936; 1938. 194 p.; 221 p. $2.25 each.

Ten years ago this reviewer formulated a plan for securing any discernible evidence regarding the results from so-called experimental ventures in education as compared with traditional procedures. After making the preliminary outline of the plan and after securing the funds to set up the study, the next step was to find someone with interest, capacity and technical training fitting him for the task. From the list of recommended candidates, Dr. J. Wayne Wrightstone was selected. An advisory committee was organized. Dr. Wrightstone has been fully responsible for the check-up. For six years he has been engaged in devising and using new-type tests by means of which to measure many specific aspects of experimental work. The accumulation of results from specific tests makes it possible to give certain tentative conclusions of a comparative nature regarding whole school programs. In 1935 a volume was published entitled "Appraisal of Newer Practices in Selected Public Schools." This entire edition was soon exhausted. The two later volumes are the subject of this review. A detailed review cannot be given in the space allotted.

In making statements drawn from these reports it needs to be clear that Dr. Wrightstone constantly says that the conclusions must be regarded as tentative awaiting further investigations, since his sampling in elementary schools aggregated a total of but 180 pupils.

The following paragraph is quoted as a summary of the accepted philosophy of the experimental schools used in this comparative study "The typical newer practices in the elementary schools are based upon an educational theory which has evolved from a number of hypotheses. Among these are the belief that the classroom is a form of democratic social life by means of which children reconstruct their experiences, that these experiences grow from children's social activities which may be integrated around central problems suggested by social activities, that pupil's interests are signs and symptoms of growing powers and abilities, that interests and powers are developed by activities rather than by passive assimilation of knowledge, and that education is the foundation of social progress and reform. There is no fixed succession of subject in the grades of newer schools."

Now what are the comparative results in the three elementary grades in reading, spelling, language and arithmetic? The newer type schools are slightly higher in all four subjects than the conventional schools. In the three upper elementary grades the newer type schools surpass by about eight per cent in language, and are not below, but not significantly above, in reading and arithmetic, the ranks in spelling not

being included. In the types of abilities called "obtaining facts," "explaining facts," and "applying facts" the differences are not significant, but the experimental schools are slightly superior. In outside interests—shop tools, pets, collections, and reading the experimental schools surpassed distinctly. In physical and mental hygiene experimental schools were superior but not markedly, except in the category called "physical fitness." In information about environmental, social, economic, and aesthetic matters, experimental schools were superior. In the small amount of testing that related to elementary science, experimental schools were superior though again the results are hardly significant.

From the volume dealing with high schools the following conclusions are drawn relative to the sciences. In recall of factual information in General Science, Biology, Psysics and Chemistry, the experimental schools surpass, the difference being small in General Science and Biology, and distinctive (18% and 33%) in Physics and Chemistry. In interpreting and applying facts the experimental schools surpass slightly. In knowledge of unfounded belief experimental schools are distinctly superior. In self-initiated and cooperative activities, both as to number and quality, experimental schools surpass by more than 30 per cent, but in ability in recitation the conventional schools surpass by fifty per cent. In personal and social adjustment no distinctive difference was shown.

The fact that the experimental schools used in this study regularly surpass the conventional schools used in this study is suggestive and encouraging, but not overwhelmingly convincing. So far as science is concerned, the results hardly justify a hasty rush to the methods of newer-type schools, unless self-initiated activities, and knowledge of unfounded beliefs are matters of deciding importance.

—O.W.C.

Bell, Eric T. *Man and His Lifebelts.* New York: Reynal and Hitchcock, 1938. 340 p. $3.00; Baltimore: Williams and Wilkins, 1938. 340 p. $3.00.

The thesis of this book is that, in all ages, men have sought security for their present, or their hereafter. One tribe might feel secure if it had enough stored food and enough fighting men to ward off hunger and its animal enemies. Thus two lifebelts, food and man defense, sufficed. All through the ages, defense by force has seemed to many to constitute the chief safety-belt for many and sometimes for most people. At recurring periods one nation may attempt to dominate all others by armed force, sometimes succeeding. Thus the belt that saved one nation caused drowning of others because they didn't have enough of it.

Then religion appeared to many to provide security. Present ills could be endured because of anchorage to a hope of future happiness. And those who declined to conform now, would suffer later in payment for their failure to put on the belt when they might have done so.

Documented charters of rights and privileges had their day as means of security, until "scraps of paper" replaced respected charters, or people dropped the charter to grab their firearms, always soon finding that security is but relative and even so, not very trustworthy.

Science, evidence, and truth came, and was hailed as the most secure of all, so staunch that it would hold everybody against any flood. But it, too, couldn't be quite unentangled from the old "buckler" of wartime. Even the lifebelt of science fell into use by the most daring of the fighters who added it to their equipment.

No conclusions are listed in the book, except by strong implications that there isn't much that holds secure against greed, injustice, and wickedness.

Doctor Bell's inimitable and vigorous writing is not always clear to us ordinary readers. His indirect figurative and voluminous vocabulary sometimes hides rather than illuminates his points. At least so it seems to one accustomed to rather constant use of simple declarative sentences designed to make points clear. But those who delight in vigorous and sometimes devious chase after brilliant ideas will find this book fascinating.

—O.W.C.

Pearl, Raymond. *The Natural History of Population.* New York: Oxford University Press, 1939. 288 p. $3.50.

This is a publication of the University of London's Heath Clark Lectures delivered by the eminent biologist-statistician of Johns Hopkins University.

The author has indicated the fundamental biological nature of the problems of population. From his own data and from generous citations and annotations of the data of others in this field, he was able to arrive at statistically supported conclusions in respect to differences inherent in biological patterns of human reproductions and those of lower mammals. He has further demonstrated a lack of fundamental difference in fertility between Negro and white groups and various economic groups, not explainable by postponement of marriage, contraceptive usage, and reproductive wastage through criminal abortion. He suggests, however, that the general decline in fertility in all groups is more closely associated with obscure factors which operate in a field not yet widely studied.

Clarity, plus a good working bibliography (though not a complete one for this field), make this book a welcome critical summary of the data of population available to those interested in biology and the social sciences as well as to the laity.

There are 48 text-figures and 52 text-tables. In addition, there are 8 pages of notes and one appendix of 34 pages containing 21 tables, and another of 15 pages containing instructions for

accurately gathering additional data for those interested in a further study of this subject.

—S. M. Nabrit.

HALLE, LOUIS J., JR. *Birds Against Men.* New York: The Viking Press, 1938. 228 p. $2.50.

This consists of seven experiences with birds, interesting and well written. The author has spent considerable time in Central America and wrote this book while in Guatemala City. The scene of many of the stories is set in his home near New York City, of others in Central America. Keen observations tinged with the personal philosophy of the author make it a book challenging to the adult mind. A full page drawing by Lynd Ward precedes each story.

—L.M.S.

DAVIS, LAVINIA R. *Adventures in Steel.* New York: Modern Age Books, Inc., 1938. 166 p. $0.75.

A fascinating book of individual stories about young workers in the steel mills and in construction work, along with a wealth of up-to-date information about the American steel industry. The book is intended for boys and girls from 12 to 16 years, but even adults find it thrilling and not easy to lay down until finished. The book is full of action. The author's experiences on the Empire State, Chrysler Building and Bank of Manhattan provided the background material for *Adventures in Steel.* Full page drawings by Frank Dobias illustrate the book.

—L.M.S.

FELT, EPHRAIM PORTER. *Our Shade Trees.* New York: Orange Judd Publishing Company, 1938. 187 p. $2.00.

This practical handbook containing reliable information for owners of shade trees, field workers, tree wardens, city foresters, superintendents of estates, is readable, definite and up-to-date. Teachers will find it a reference book for historic trees, laws, legislation and development of shade tree work, detailed directions for the care of shade trees, fungous diseases, insect pests and their control, other sources of injury, the proper trees to plant.

The book is illustrated with full page photographs of good quality.

—L.M.S.

HALL, CARRIE A. *From Hoopskirts to Nudity.* Caldwell, Idaho: The Caxton Printers, 1938. 240 p. $5.00.

This is "a Review of the Follies and Foibles of Fashion" from 1866–1936, giving a complete summary of the development and changes of women's fashions. Its value is enhanced by copious photographs by Mary Ellen Everhard. The author gained her knowledge of fashions from fifty years of designing and making more than 20,000 dresses. She interprets the changes in style in clear and clever language, making the book readable and unique as a source book on fashions throughout the past seventy years. From the standpoint of women's health as influenced by clothing the book has educational significance. There is scarcely a women who could not benefit from the book and experience a good laugh as well.

—L.M.S.

PALMER, RACHEL LYNN AND ALPHER, ISIDORE M. *40,000,000 Guinea Pig Children.* New York: The Vanguard Press, 1937. 249 p. $2.00.

This book is an able and arresting discussion of child health, concerning itself primarily with problems of child nutrition in families in comfortable circumstances. It not only exposes by "naming names" of misleading and fraudulent claims of advertising such as come to every family through the newspapers, magazines, and the radio, but it gives constructive advice. An excellent chapter on the foods children need is followed by chapters on milk and milk products; the place of cereal and bread in child diets; sweets; poisoning through contamination of food and water by arsenic, lead, selenium and fluorine; the vitamins; laxatives; colds; playtime (toys, sports, radio, movies in the lives of children). This is a useful book for parents. It also is a good book for reference for high school science classes from the standpoint of nutrition as related to consumer education.

—L.M.S.

FISHER, IRVING AND EMERSON, HAVEN. *How to Live.* New York: Funk and Wagnalls, 1938. 402 p. $2.50.

Living very much up to the promise of its sub-title, "Rules for Healthful Living Based on Modern Science" this is a completely revised and rewritten edition of a classic in its field which has sold 449 thousand copies of previous editions. It is a thoroughly sound and readable presentation of a rational basis for personal living. Part I, Our Exterior, covers functions of the skin, clothing, housing, out-door living; Part II, Our Interior, treats of eating and diet, poisons, mouth hygiene, colon hygiene, and infection; Part III, Our Behavior, covers work hygiene, exercise and recreation, relaxation and sleep, serenity and poise; Part IV, is titled Hygiene in General. An "appendix" which in the matter of pages comprises over half the book is made up of thirty-two papers, each presenting research, case histories, or further detail of information with regard to the scientific foundation upon which the first part of the book is built. Titles of a few of these papers taken at random to illustrate their scope are 1. Low Protein Diet, 5. Self-selection of Diet by Students, 7. The Vitamines, 10. Alcohol, 11. Tobacco, 14. Exercise, 17. Overweight, 21. The Common Cold, 23. Syphilis and Gonorrhea, 25. The Cancer

Problem, 29. The Gall Bladder, 31. Eugenics. Most of these papers contain a selected list of references.

—O. E. Underhill.

Clark, John A., Gorton, Frederick Russell and Sears, Francis W. *Physics of Today.* Boston: Houghton Mifflin Company, 1938. 632 p. $1.80.

The varied background of the authors of this high school text, the first experienced in the teaching of physical science in the high school and now chairman of the Standing Committee on Science for the Public High Schools of New York City; the second, head of the department of physics and astronomy at Michigan State Normal College and the third, assistant professor of physics at M.I.T., should insure technical accuracy combined with sound pedagogy.

One feature of the book is the many experiments, with simply assembled and constructed apparatus. A number of these are unique and ingenious. The many clear diagrams and photographs are exceptionally well chosen. It is a very excellently planned and organized text. The reviewer is pleased to see the statement that the three classes of lever have been included "not because they are necessary but because they are in common use." Perhaps this admission is the first step toward the elimination of what has always seemed to him to be an unnecessary complication introduced because of tradition. Each chapter contains exercises with the more difficult ones starred so that they may be assigned as "honor work." A completion test is given for each chapter.

—O. E. Underhill.

Lake, Charles H., Harley, Henry P. and Welton, Louis E. *Exploring the World of Science.* New York: Silver Burdett Company, 1939. 720 p. $1.80.

This general science text is correctly titled, for it truly does explore the world of science. More space is devoted to the principles of physics and chemistry than is found in the usual general science. It is more inclusive than the ordinary science text, each field of science being treated in detail.

This is a revised edition of the 1934 general science text of the same name. The authors, all of Cleveland, Ohio, are well experienced in the science teaching field.

The subject matter is well organized into sixteen units, each with (1) an overview and exploratory questions; (2) experiments; (3) informational materials; (4) self-testing exercises; (5) thought questions and problems; (6) projects and activities; and (7) suggested readings. To provide effective motivation for each chapter, the authors have provided "Do You Know" questions of the "Believe It Or Not" type, such as "Do You Know: That you and everything else in the world are made of only ninety-two kinds of building 'brick'? That Greenland once had a tropical climate? What man's keenest competitor for the food supply of the world is?"

The illustrations are clear-cut and up-to-date. A workbook and accompanying test by the same authors are available.

—Roy V. Maneval.

Allen, Arthur A. *The Golden Plover and Other Birds.* Ithaca, New York: Comstock Publishing Company, 1939. 324 p. $3.00.

Any bird lover, from the junior high school pupil to the ornithologist, will find something of interest in this, another series of bird biographies by Dr. Allen of Cornell University. Its illustrations are outstanding, with 240 photographs by the author, and seven bird portraits in color by Dr. George Miksch Sutton. The autobiographical form is used to tell in a most interesting manner the important facts about twenty-seven North American birds. Questions about the life history of each bird are listed on the last few pages of this volume.

Birds giving their autobiographies, besides the golden plover, are the willow ptarmigan, tree sparrow, cardinal, veery, starling, vireo, indigo bunting, song sparrow, white-breasted nuthatch, crow, crested flycatcher, chippy, downy woodpecker, prairie horned lark, meadowlark, bank swallow, nighthawk, marsh hawk, cedar waxwing, pied-billed grebe, Florida gallinule, rail, red-wing, double-crested cormorant, sandhill crane, and wild goose.

—Roy V. Maneval.

Comstock, John Henry, Comstock, Anna Botsford and Herrick, Glenn W. *A Manual for the Study of Insects.* Ithaca: Comstock Publishing Company, 1938. 401 p. $4.00.

In this Twenty-second revised edition, Professor Herrick has brought up to date one of the exceedingly good manuals of entomology in addition to a manual that furnishes a large amount of information that the student can acquire with great ease. It is easily read and well adapted to use in courses in systematic entomology.

The book is well illustrated, especially with those structures which assist in identification. Professor Herrick has brought the classification of insects up to date in light of the information that has been accumulated in the last few years.

It is extremely difficult to assemble in one small volume the abundance of material that one needs in studying the whole group of insects. Professor Herrick in his revision of this manual has put before the student as much material as it seems can be included in one volume.

—E. C. Harrah.

Comstock, Anna Botsford. *Handbook of Nature Study.* Ithaca, New York: Comstock Publishing Company, 1939. 937 p. $4.00.

That Mrs. Comstock's original handbook, copyrighted in 1911, went through twenty-three

editions without enough changes to require a new copyright attests its remarkable quality and popularity. This twenty-fourth edition of the late Mrs. Comstock's handbook has been thoroughly modernized in appearance, in new illustrations, and in new material that has recently made its way into the science program of the elementary grades. Some twenty experts assisted in making this revision possible and yet the same general style of treatment so successfully used in the original volume has been maintained. The main divisions are: I. The Teaching of Nature Study; II. Animals; III. Plants; IV. Earth and Sky. This last unit has been greatly expanded. A useful bibliography is added. The book should find a place in the schoolroom of every grade.

—W.G.W.

DARLING, F. FRASER. *Wild Country.* New York: The Macmillan Company, 1938. 104 p. $2.75.

The author states "The book is a scrap-book about nothing in particular, but will touch on many aspects of the countryside in which I happen to live." He claims to be only a novice with the camera, yet the beautiful photographs of scenery and of wild life in a natural setting—rarely recorded by man—show his mastery of nature photography. It is a British book and treats of many kinds of life not common in America. Interest in the book is largely due to the intimate associations of the author with the "creatures of island, mountain, sea, and moor."

NEEDHAM, JOSEPH and PAGEL, WALTER (editors). *Background to Modern Science.* New York: The Macmillan Company, 1938. 243 p. $2.00.

This collection of ten lectures by ten professors of the University of Cambridge presents a survey of the background of modern science. The first two chapters cover the beginnings of science up to Galileo's time. The other eight chapters cover 40 years, each of the following: physics, crystal physics, atomic theory, astronomy, physiology and pathology, parasitology and tropical medicine, evolution theory, and genetics. The lecturers themselves have been leaders in the modern progress of science and are well known. Cornford, Dampier, Rutherford, Bragg, Aston, Eddington, Ryle, Nuttall, Punnett, and Haldane. You will find this book by these leaders in science extremely interesting.

—W.G.W.

MCCORKLE, PAUL. *Survey of Physical Science.* Philadelphia: P. Blakiston's Son and Company, Inc., 1938. 471 p.

This is a new text book in a field which is already over-crowded. The text differs from many of the others in the arrangement and quantity of material. The subject matter may be divided roughly into a brief discussion of Astronomy and Earth Science, Physics and Chemistry. The book is very well illustrated. The material is scientifically correct but lacks depth. It would serve for a very short course on the subject. The arrangement of the material is well worked out in that it follows a sequence developed by the author. Whether this sequence is right or the best, is another question. The explanation of principles is very good. It is a subject matter book and the problems which may arise in the mind of the student will still be unanswered as far as method of finding these solutions in the text are concerned. Little thought or attention has been given to teaching the student the scientific method and the matter of problem solving. No thought has been given to the organization of the material around these points. If the main objective of a course of this sort is to simply relate a lot of factual knowledge and principles without regard to their use by the student, then this is a good book. Otherwise it is just a new text. It will be found that this is a very good reference work in either high school or college.

—F. L. Hermon.

YATES, RAYMOND F. *These Amazing Electrons.* New York: The Macmillan Company, 1937. 326 p. $3.75.

This is a popular book on the electron. It discusses the uses to which electrons have been put by modern developments in the art of vacuum tubes. The material has been well handled by an experienced writer. Mr. Yates has an eye for the popular appeal but at the same time scientific accuracy has not been neglected. The book will be found to be interesting reading and well worth the trouble for the majority of readers whose intent is not too serious. For the serious student several points of interest and importance will be found in the text. The author discusses the atom, waves and light, electrons in wires and their uses to man, sound, radio, television, cosmic rays, light from electrons, and some incidental applications of electrons such as the photoelectric cells. It will be found that this will serve as a fine reference book for high school and college students. It should be kept in mind that this book is of the popular type and as such serves as a source of general information.

—F. L. Hermon.

DUNLAP, ORRIN E., JR. *Marconi, The Man and His Wireless.* New York: The Macmillan Company, 1937. 360 p. $3.50.

The author of this biography of Marconi is one who has been closely associated with radio and well trained in the field of radio. The book was written under the supervision of Marconi, so the details are accurate as to time, place and development. The book is very well written. It is worthy of the serious reader as well as for the popular reader. The book recounts events in the life of Marconi from his childhood. It

traces the development of the investigations which led to the first practical radio. The place which radio has come to occupy in our daily lives is traced along with the slow painful process of its growth. It is the opinion of this reviewer that every one who has the opportunity to read this book should do so. In it will be found the drama of science and the means by which great ideas grow.

—F. L. Hermon.

DANTZIG, TOBIAS. *Aspects of Science.* New York: The Macmillan Company, 1937. 285 p. $3.00.

This volume is the second book by this author dealing with the place of reason and logic in science. The author expresses his thesis in these words which explain the plan and purpose which he had in mind. "This book is an essay on faith. Not the faith which grew out of weariness and fear of oblivion, and which projected life beyond life, but faith in the reign of reason, which was to conquer fear and lead the triumphant march of man towards a more abundant life." It will be found that the work is a classic in logic and in philosophy. For the reader who is not inclined toward these processess of thought it will be found that the book is hard to read and at times difficult to follow. However, the book is well written and furnishes much food for serious thought. The theme set up by the author is well developed and reaches a logical conclusion. It can be seen that the viewopint of the mathematician is ever present. Many of the short coming of science are pointed out in the light of the logic of mathematics. One is apt to reach the conclusion, after reading this work, that the ultimate solution of all the difficulties in science will be found in mathematics. The author makes this statement as his concluding sentence which may be taken in a number of different ways. "Read your instruments, and obey mathematics; for this is the whole duty of the scientist." This book does furnish many interesting points and at least will cause the scientist to sit up and take heed. It should be kept in mind that the scientist has other duties than those which are indicated in the author's conclusion.

—F. L. Hermon.

RICHARDS, HAROLD. *The Universe Surveyed.* New York: D. Van Nostrand Company, 1937. 722 p. $3.50.

The author has in this volume incorporated interesting material in physics, chemistry, astronomy, and geology. It is well written and reasonably well illustrated.

The book is intended for a survey course in science, and while each field is surveyed, there is little indication of integration. In a book of this type the freshman student would have difficulty to make general interpretations that would enable him to understand the phenomena that he meets throughout life.

The book includes many original photographs of scientific phenomena difficult to reproduce, and these contribute much to its attractiveness and usefulness and no doubt make a contribution to the field.

—E. C. Harrah.

WATKEYS, C. W. and ASSOCIATES. *An Orientation in Science.* New York: McGraw-Hill Book Company, 1938. 560 p. $3.50.

The authors have put together in one volume a large body of factual material which should command the respect of every scientist. The book is reasonably well written but is too difficult in many places for freshmen.

There is little integration of material selected from the various fields of science except in the chapters on chemistry and physics. If the book is used at the end of the college course, after students have had the basic sciences, it would serve an excelient purpose.

The book is quite technical in most phases and does not deal with a general interpretation that would serve to orient the student with respect to the phenomena of the world in which we live.

—E. C. Harrah.

BUCHSBAUM, RALPH. *Animals Without Backbones.* Chicago: University of Chicago Press, 1938. 371 p. $3.75.

Professor Buchsbaum has done an excellent job in portraying invertebrate life. The book is so well illustrated that if a student studies the illustrations only, he would get some interpretation of the composition of invertebrates. The author and publishers are to be commended on the clarity and perfection of this work. The text material is so clearly written that one should have little difficulty in arriving at correct interpretations.

The only difficulty I foresee would be the technical names which must be used in material of this kind.

—E. C. Harrah.

HAYWORD, HERMAN E. *The Structure of Economic Plants.* New York: The Macmillan Company, 1938. 674 p. $4.90.

This volume presents a new work on structure of plants. It is divided into two parts. The first four chapters comprise Part I, dealing with general plant anatomy, such as cells and tissues and their development, the anatomy of the root, shoot, flower, and fruit.

The author then turns his attention to the structure of many of the economic plants, such as corn, wheat, onion, hemp, beet, radish, alfalfa, and a number of others.

The illustrations are in the main original and are very clear and distinct. The text material is scientific and well prepared. It is, as the title indicates, a specialized work in plant anatomy and as such is an outstanding production.

—E. C. Harrah.

ILLINGWORTH, R. E. *Chemical Analysis for Medical Students.* Baltimore: William Wood and Company, 1938. 152 p. $1.50.

This text is divided into three parts which are as follows: Part I Qualitative Inorganic Analysis, Part II Qualitative Organic Analysis, Part III Volumetric Analysis. This is a great deal of material to attempt to cover in 150 pages, especially since thirty of them are blank to allow the student to include notes in the book.

The qualitative analysis reactions consist mainly of isolated tests rather than separation schemes. The volumetric section contains a number of useful titration methods. A short appendix and a logarithm table are included.

The book is apparently designed for those who have had elementary courses in inorganic and organic chemistry. No theoretical material is included which seems to indicate that the author intends that the book be supplemented by lectures.

In spite of its shortcomings this text does present a compact source of tests and analytical methods. However, in the opinion of this reviewer, it does not seem suitable for analysis courses as given in American schools.

—P. E. Hatfield.

THORPE, WILLIAM VEALE. *Biochemistry for Medical Students.* Baltimore: William Wood and Company, 1938. 45 p. $4.50.

This book, as the name implies, is intended principally for medical and dental students. However, anyone wanting a general knowledge of biochemistry will find this book quite useful. This text contains the wealth of material usually found in English chemistry books. Much of the material presented is difficult to find in the average biochemistry text. Four parts make up the book. Part I contains material on physical chemistry related to biochemistry together with eight chapters on the chemical composition of the body. Part II is concerned chiefly with the utilization of various substances within the body. Part III deals with nutrition and the composition of common foods together with a short section on excretions. An appendix containing a number of tables and a bibliography are included.

The author has made his book as up to date as possible. For example material is included on the physiological effect of heavy hydrogen and the use of nicotinic acid in pellegra.

A knowledge of elementary organic chemistry is necessary to appreciate this book.

—P. E. Hatfield.

HANGER, ERNEST O. and LOWE, PAUL S. *Directed Studies in Biology.* Chicago: Mentzer, Bush and Company, 1937. 312 p. $0.96.

HANGER, ERNEST O. and LOWE, PAUL S. *General Biology Tests.* Chicago: Mentzer, Bush and Company, 1938. 64 p.

This is an attempt to direct the studies of high school pupils in the course in general biology and is to be used with any of the existing general biology textbooks. The work is planned on a contract basis for six six-weeks' periods with a point system and with letter grades for pupils suggested for each set of exercises within the six-weeks period. The work of the course is divided into ten major units as follows: The Scope of Biology, A Study of the Cell, Biological Principles as Applied to Specific Types of Animals, Biological Principles as Applied to Specific Types of Plant Life, Field Studies, Biological Principles as Applied to Man, Biological Principles as Applied to the Interrelationship of Organisms, Conservation, Heredity, and A Study of Some Leading Biologists and Their Contributions. Each unit is set up on a definite pattern providing a preview statement of the objective and workbook exercises. Exercises are varied in kind and provide considerable opportunity for pupil initiative. A working bibliography is provided in the appendix. The last fifteen pages are blank and indicated as spaces for students notes.

The test booklet includes 17 tests. The organization of the test program does not correspond exactly to the unit organization of the workbook. The exercises of the workbook covered by each are clearly marked in the table of contents in the test booklet. Most of the tests include a composite of test forms; the commonest forms are true-false, matching, multiple-choice, and completion. The change in form within each test is clearly marked with a different set of directions for the changed test form. Some test makers will object to the short sections of some test forms on the grounds of reliability. Many of the tests include sections of true-false items running from 6 to 12 items in length.

—R.K.W.

COOK, S. G. and DAVIS, IRA C. *Combined Laboratory Manual and Workbook in Physics.* Chicago: Mentzer, Bush and Company, 1938. 238 p. $0.80.

COOK, S. G. and DAVIS, IRA C. *Physics Tests.* Chicago: Mentzer, Bush and Company, 1937. 62 p.

This workbook is intended to accompany the current textbooks for high school physics. There are 98 exercises with no grouping into units or major divisions. Exercises are divided into four types: experiments, directed study, demonstration and review. Almost all the material is worked through leaving very brief spaces for pupil responses. Experiments and demonstrations are well illustrated with diagrams of apparatus.

The test booklet provides for 23 tests grouped under such headings as Energy, Matter and Molecular Motion, Pressure in Liquids and Gases, Accelerated Motion, etc. The exercises covered in the workbook for each of the tests are indicated by test titles. Tests are primarily of the completion and true-false types. Many groups of true-false exercises are brief. Some

tests provide for the working of problems and spaces for marking the answers to problems. To this reviewer the use of both workbook and tests would be heightened in convenience if the workbook were divided in major units to correspond to the divisions covered by the tests.

—R.K.W.

Davis, Ray E. and Davis, Ira C. *Combined Laboratory Manual and Workbook in Biology.* Chicago: Mentzer, Bush and Company, 1938. 238 p. $0.80.

Davis, Ray E. and Davis, Ira C. *Biology Tests.* Chicago: Mentzer, Bush and Company, 1938. 62 p.

This is a biology workbook intended to accompany any of the existing textbooks in high school biology. The workbook material is set up under four major divisions. Division I has to do with matter and energy changes necessary for the understanding of biology; Division II with animal life; Division III with the human body; and Division IV with plant life. There are a total of 95 exercises. A definite scheme for carrying through the exercises is outlined for the pupils in the introduction of the book. Considerable opportunity for planning and thinking is left to the pupil. There si less emphasis upon right responses to a large number of detailed questions than in other workbooks produced by the same publisher.

Some biology teachers may object to the division of the material into distinct phases of animal, plant and human biology. For teachers who plan general biology courses with these three divisions, the work book will be found satisfactory in many ways.

The test booklet provides 26 tests. Each test covers several of the exercises provided in the workbook. Apparently the test booklet is set up on a unit plan; the units which correspond in the workbook are not marked on the same plan. Most of the test exercises are completion exercises, although there are occasional matching exercises and some few multiple-choice.

—R.K.W.

Conn, Kenneth E. and Briscoe, Herman T. *Combined Laboratory Manual and Workbook in Chemistry.* Chicago: Mentzer, Bush and Company, 1935. 430 p. $0.80.

Conn, Kenneth E. and Briscoe, Herman T. *Chemistry Tests, Forms A and B.* Chicago: Mentzer, Bush and Company, 1936. 60 p. each.

The workbook is divided into 25 units covering the usual range of high school chemistry. It is intended to accompany any one of fifteen or twenty high school chemistry texts. The work for each unit is divided into experiments and study outlines, with the experimental exercises coming first. Included in the workbook is a short self-administering test for each unit. These tests are quite brief, usually running 10 or 12 test exercises. The spaces for workbook responses are, for the most part, short-answer spaces with the organization of the responses indicated by the exercise. Rather a large number of blank pages are left for student notes. The workbook gives the impression of a large amount of detail for one high school course.

The tests in the test booklet, Form A, by the same authors, correspond to the units of the workbook with the exception that Test 25 is a final examination instead of covering Unit 25 of the workbook. Nearly all of the test exercises are of the completion type. There are a few true-false tests. The final examination consists of 71 test items, 27 of which are true-false and the remainder completion.

Form B of the test booklet corresponds in units to Form A. The majority of the tests in Form B are true-false exercises. This is varied with a sprinkling of multiple-choice tests, and with occasional completion tests. The test forms for corresponding units, that is between Forms A and B, are not always on the same pattern.

—R.K.W.

Painter, D. H. and Skewes, G. J. *General Science Tests.* Chicago: Mentzer, Bush and Company, 1937. 64 p. (23 tests.)

These tests are prepared to accompany the general science workbook by the same authors. The exercises are of the matching, true-false, completion, and multiple-choice types. The pattern of type of test varies with the topic tested. There is considerable variability in the number of exercises of one sort from test to test. Test booklets are perforated for the removal of used tests.

A considerable volume of test material is here made available for teachers in usable form. Whether or not this material is to be used by any given teacher depends upon the validity of the test material presented for the actual teaching done in the given situation. Teachers will find these tests satisfactory if the topics listed fit the teaching actually being carried on. No indication is given in the tests of how the adaptation of material to teaching the situation in general has been made.

—R.K.W.

Painter, D. H. and Skewes, G. J. *Directed Studies in General Science.* Chicago: Mentzer, Bush and Company, 1937. 242 p. $0.80.

This is a workbook intended to accompany any of the existing textbooks in general science. It consists of 112 exercises, each divided into many briefer exercises. Although the larger exercises give unity to the whole, the actual numbered exercises consist largely of short-answer, pencil and paper responses, in which the organization has been largely done by the authors and little independent organization left to the pupil.

Mechanically the book is perforated so that the teacher can remove worked exercises as they are completed. The teacher carrying on general science largely as a text-response type

of learning with limited equipment will be interested in this workbook. Teachers who believe in freer opportunities for pupils to organize their own thinking about science will prefer exercises devoloped on some other basis.

—R.K.W.

PROCTOR, MARY. *Our Stars Month by Month.* New York: Frederick Warne and Company, 1937. 92 p. $1.00.

This little book of British authorship contains exactly what the title indicates. There are star maps for each of the twelve months beginning with September and running on through August. The maps are done with a dark blue background; stars and constellations are shown in white. These maps are clear and exceedingly simple to follow. The time for the maps is set for latitude 40° north that of New York City. Local users can easily check the time by referring to monthly star maps published by local newspapers and such sources.

This book is recommended for amateur astronomers interested in constellations and for junior high school science classes. It is recommended for purchase for science libraries of nearly all high schools.

—R.K.W.

WITTICK, EUGENE C. *The Development of Power.* Chicago: The University of Chicago Press, 1939. 164 p. $1.00.

This is one of a series of units worked out by members of the staff in the laboratory schools of the University of Chicago. It is intended as material for courses in industrial arts. Chapters include the following: "Wind Power," "Water Power," "Steam Power," "Internal Combustion," "Electrical Power," and "Power Transmission." Each chapter is introduced with the material on the historical development of that particular source of power. This is followed by descriptions of modern engines and machines developed for the utilization of the kind of power. The historical material is quite brief; the explanatory diagrams are excellent.

This small volume will be found useful as supplementary material for teachers of classes in high school physics or of the new course in senior high school physical science. Superior pupils in general science courses will be able to read parts of it.

—R.K.W.

REED, HOMER B. *Psychology and Teaching of Secondary School Subjects.* New York: Prentice-Hall, Inc., 1939. 684 p. $3.25.

This book is intended as a contribution to educational psychology as applied to secondary school subjects. As a textbook, it is more definitely applicable to courses in the psychology of high school subjects than to courses in general methodology or teaching techniques.

The author is Professor of Psychology at the State Teachers College in Fort Hayes, Kansas. The first section of the book deals with the general principles of learning. The following chapters deal with applications to the fields of English, foreign languages, typewriting, social studies, mathematics and science. No consideration is given to possible psychological interpretations of new forms of organization of teaching materials and some of the existing fields now widely taught in high schools, such as music, art, industrial arts, and home economics, are missing. With the exception of typewriting the material deals with the psychology of the older academic subjects. Much use is made of experimental investigations and frequent footnote reference to these is used. Bibliographies are adequate.

The author frequently strays from the field of experimentally derived psychological factors over into the field of philosophical derivation of objectives and the social implications involved in the uses of school subjects. The reader needs to use caution in determining when the material presented is verifiable in terms of psychological experimentation and when the sources are those of the author's opinions.

The book is recommended for consideration of teachers of psychology for secondary school teachers and for reference for teachers and students of methods in secondary education.

—R.K.W.

BEEBE, WILLIAM. *Zaca Venture.* New York: Harcourt, Brace and Company, 1938. 308 p. $3.00.

The first recommendation for this book is that it is another of the adventures of William Beebe. The adventures are concerned with a cruise for collecting marine specimens around the coast of Lower California. The cruise carried Dr. Beebe from San Diego down the Pacific coast, around the point of Lower California, up into the Gulf of California, and back again. Since this country has been little described in travel literature, Dr. Beebe's book will open a new geographical, as well as scientific, district to many readers. Fishermen will be interested in the description of his first attempt at game fishing with rod and reel.

The book is to be recommended to all readers interested in travel and adventure and for the science libraries of high schools.

—R.K.W.

LENZEN, VICTOR F. *Procedures of Empirical Science.* Chicago: University of Chicago Press, 1938. 59 p. $1.00.

This is number 5 of Volume 1 of the International Encyclopedia of Unified Science, of which the first two volumes are devoted to the foundations of the unity of science. "The concepts of empirical science are reducible to those which express the properties of spatio-temporal things." (p. 3) "The basic procedure of empirical science is observation." (p. 4) Observation involves counting, measuring, length, time,

weight. "Nonperceptible entities are also inferred to exist as the hypothetical causes of perceptible phenomena." (p. 24) Such are the electrons, protons. Then follows systematization including classification, correlation of events, successive approximation, definition, atomism. Each of these procedures is analyzed and clarified by examples.

The hope is expressed "that quantum mechanics and the theory of relativity may be united in a single theory." "The progress of physics toward unity augurs well for the unity of all empirical science."

—E.R.D.

GRAUBARD, MARK. *Man the Slave and Master.* New York: Covici-Friede, 1938. 354 p. $3.50.

The author says in his preface "This book attempts to correlate some basic principles in the fields of physiology, embryology, heredity, biologic, cultural and social evolution and indicate the benefits that knowledge of these principles bring to the solution of problems of race, eugenics, art, social progress, democracy, habit, custom, moral and ethical ideals, war and so on." That seems a large order to fill. It does give a fairly accurate, brief survey of these fields that will give to the person unfamiliar with them an acquaintance with their major findings in so far as they bear upon the problem indicated.

There are several contradictions. For example he says on p. 186, "The last ice age ended about 20,000 B.C.," while on p. 213 is the statement, "the ice melted around 6000 B.C." Again, p. 226 "fully separated human groups will evolve along basically similar lines," while p. 173 says, "isolated groups of the same species tend to become differentiated."

The book is dogmatic. It reads more like propaganda than unbiased science. "All (human) races are fertile with each other. Hence they form a species" (p. 195). But Whitman found pigeons belonging to different genera were fertile *inter se*. "Genes are usually situated in different chromosomes" p. 262. But over one hundred genes are found in a single chromosome in the fruit fly and there are only seven chromosomes. "Without forceful control selection is impossible" (p. 315). Surely in human matings it can be voluntary. "Religion failed because it was based on sentiment and idealism and not on reality." (p. 335).

He proposes a new panacea for human ills, namely "scientific humanism" which "takes the welfare of humanity, of the species as a whole, as its keynote" (p. 344). That sounds much like what religion has called the brotherhood of man. "Every individual should share all that the genius of homo-sapiens has produced, both material goods and cultural knowledge. It requires "the elimination of unequal distribution of wealth, social control and utilization of national resources, rasing the economic and cultural level of each individual to the maximum of which the species is capable, the elimination of war, national and racial hatred and political inequality" (p. 346). That smacks a bit of idealism. It is to be heartily commended. Perhaps scientific idealism and religious idealism can meet on common ground.

—E.R.D.

BRUGUIERE, EMILE. *1939 Photo Almanac.* New York: Falk Publishing Company, 1939. 268 p. $1.00.

This unusually good 1939 Photo Almanac and market guide includes the following articles: (1) Outdoor Sports Photography by Richard K. Wood, (2) What Your Darkroom Needs by Lloyd J. Snodgrass, (3) Portraits of Automobiles by Kip Ross, (4) Now Its Synchro-Sunlight by Herbert C. McKay, (5) Filter: Why, When, and How by F. Seymour Hersey, (6) The Photo Almanac, (7) Photography 1938–39 by Emile Bruguiere, (8) Pictorial Section, (9) Formulary and Data Book, (10) Bibliography, (11) The Universal Market Guide, (12) Dealer Listings, (13) The New Portraiture by Max Thorek, (14) The Control of Contrast by Lloyd J. Snodgrass, (15) Have You Tried Photomacrography by John F. Brandt, (16) Eliminating Glare and Reflection by R. Pfeiffer, Jr., (17) In the Modern Trend by Nicholas Hoz, (18) Free Lance Photography by Karl A. Barleben, (19) The Candid Scores a Scoop by Jackie Martin, (20) Reviving the Fresson Process by Edward Alenius, (21) A Way to Better Portrait Lighting, and (22) Snapshots in Natural Color by T. Thorne Baker.

—C.M.P.

SYMPOSIUM. U. S. Camera Magazine, Autumn Number. New York: U. S. Camera, 1938. 72 p. $0.50.

This is Volume One, Number One of a new adventure in magazine photography. There are numerous excellent photographs and several splendid articles. Included among these articles are the following: (1) Good Pictures by Edward Steichen, (2) Hungry Hydra Well-Fed, (3) Lens-Lines, (4) Thanks, Camera by Rockwell Kent, (5) Babies by Ruth Nichols, (6) Scenes of Old Spain, and (7) When You Buy an Enlarger by Willard D. Morgan.

—C.M.P.

Birds of the World. Chicago: Albert Whitman and Company, 1938. 207 p. $1.75.

This volume is one, of the projects of the Federal Writers' Project done under the Works Progress Administration in the City of New York. The plates have been prepared by workers in the Federal Art Project.

It consists of a series of plates and descriptions of selected types to illustrate the various orders and classes of birds of the world. The species selected are typical and the descriptions accurate.

The book is in no sense a key that can be

used for identification of birds in any local community. The student of birds will be disappointed if he expects to use this volume as a key for helpful identification of birds in his own environment. For this reason the book will have very limited usage as furnishing illustrations of the differences among birds of various orders.

Teachers may find some value in using the pictures and the descriptions to bring out differences among birds of different orders in the classification of birds. The amateur who wishes to extend his knowledge of many birds within the same order will not find this book a profitable investment.

—R.K.W.

Were We Guinea Pigs? New York: Henry Holt and Company, 1938. 303 p. $2.00.

This intriguing volume is a description of the experiences of the first senior class of the University High School of Ohio State University. The members of this class had completed the six years of work in the junior-senior high school of this institution.

It is apparent that the book was stimulated by school teachers and officials who expected that the volume might stand as an evaluation of the work of one of the progressive schools. As an evaluation there is evidence that these young people have gained from their experiences. Whether they have gained more or less than a similar group of young people have gained in some other institution is not proven. Perhaps there is no intention to offer evidence of this kind. The book itself is evidence of attainment, achievement, and literacy on the part of the authors. The reader is inclined to the impression that this group is rather a highly selected group as compared with high school pupils in general. The description of the background of the pupils themselves in Chapter One seems to bear this out.

The description of the work done in the areas of instruction do not seem radically different from much of the training now being offered in many well organized public high schools. The case studies reported under the heading "Records and Reports" are anything but convincing as records of accomplishment and as offering proof for the values of particular work done.

Finally, to return to the original thesis, the most convincing evidence of achievement of these young people is their ability to get together the record and report of the six years of work as shown by this book itself.

All secondary school teachers and all administrators interested in trends in recent secondary education will be interested in this volume.

—R.K.W.

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